# Joint MOE/Environment Canada/MEA
# Municipal Sewage Treatment Plants
# Pilot Monitoring Project
# Volume 1 - Final Report

**Submitted to:**

**Ontario Ministry of the Environment**

**Prepared by:**

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File No.: AN873095

January 21, 1988

Mr. Tony Ho
Water Resources Branch
Ontario Ministry of the Environment
1 St. Clair Avenue West
TORONTO, Ontario.
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Dear Tony:

RE: **MISA - 40 STP: FINAL REPORT**

We are pleased to submit the final report for the MISA 40 STP Trace Organic Contaminants Analysis. This report gives the analytical methods, a summary of QA/QC results and observations made during analyses of phenols, volatiles and dioxins for P.O. No. A96398 by ZENON Environmental Inc.

Thank you for the opportunity to be involved in the MISA program. We look forward to working with the Ontario Ministry of the Environment in the future.

Yours truly,

John A. Coburn
President

JAC:mk
enclosure

anpk

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# 1.0 **INTRODUCTION**

## 1.0 INTRODUCTION

The purpose of the MISA program is to gather information from 40 sewage treatment plants to support the development of a cost effective and workable Monitoring and Compliance Regulation.

The necessary information involves analysis of up to 920 municipal sewage plant samples including sludges, influents and effluents using GLC/ECD or GLC/MS. From this information a short list of hazardous contaminants for routine monitoring in municipal discharges will be developed and established in the regulatory program. The regulatory program will be put into effect in early '88. Province-wide compliance limits for hazardous contaminants in sewage treatment plant effluents and sludges will follow in 6-9 months based on BAPT.

Analysis of 920 samples required the involvement of 3 labs. Thes three included Enviroclean, Mann Testing, and ZENON Environmental Incorporated. Enviroclean is responsible for analysis of organochlorine pesticides, and phenoxy acid herbicides. Mann Testing analyzes for base/neutral extractables and acid extractables. ZENON is responsible for analysis of volatile organics, PCDD/PCDF and total phenols. ZENON is also acting as the single lead laboratory responsible for coordination of the project.

Complete results of the analyses of volatile organics, PCDD/F and total phenols are presented in this report.

# 2.0 RESULTS AND DISCUSSION

## 2.1 ACID/BASE/NEUTRAL EXTRACTABLES

To be provided by Mann Testing

## 2.2 Volatile Organics (VOA)

Forty-nine compounds were analyzed for volatile organics. Table 2.2.1 includes all 49 compounds with their Chemical Abstract Service (CAS) Registry Numbers, the method detection limit (MDL) of each matrix, the supplier and the purity of the standards used.

The determination of the MDL for volatile organic compounds was established in the following manner:

The response of low level standards and the background noise levels in water blanks were used to establish a reliable minimal response which would give a signal to noise level of at least 3:1. Any additional dilution factors would then be taken into account when required.

### 2.2.1 Analytical Method

Samples were processed by a purge and trap technique and analyzed by GC/MS. Two analytical set ups were used for the analysis of volatile organics. Samples from ZE04-0001 to ZE10-0028 were analyzed using a NUTECH 8522 concentrator coupled to a Finnigan 4510 GC/MS with Incos data system. All subsequent samples were processed using an Envirochem Series 810 Volatiles Analyzer coupled to a Hewlett-Packard mass selective detector. Complete instrument details are provided in Appendix 2.2.3.

Sample volumes varied with sample type. Generally the following sample volumes were used:

| | |
|---|---|
| Final Effluent | 3.0 mL |
| Raw Sewage | 0.15 mL |
| Sludges | 0.01 mL |

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUNDS

Project ID: AN873095

| ANALYTE LIST | CAS # | RAW SEWAGE MDL (ug/L) | SLUDGE MDL (ug/kg) | EFFLUENTS MDL (ug/L) | SUPPLIER | PURITY |
|---|---|---|---|---|---|---|
| Chloromethane | 74-87-3 | 40 | 400 | 2 | SUPELCO | >99% |
| Dichlorodifluoromethane | 75-71-8 | 40 | 400 | 2 | ALDRICH | >97% |
| Vinyl Chloride | 75-01-4 | 40 | 400 | 2 | SUPELCO | >99% |
| Vinyl bromide | 593-60-2 | 60 | 600 | 3 | MATHESON | 97% |
| Chloroethane | 75-00-3 | 40 | 400 | 2 | SUPELCO | >99% |
| Diethyl ether | 67-64-1 | 40 | 400 | 2 | ALDRICH | >99% |
| Trichlorofluoromethane | 75-69-4 | 40 | 400 | 2 | SUPELCO | >99% |
| Bromoethane | 74-83-9 | 40 | 400 | 2 | ALDRICH | >99% |
| 3-Chloro-1-propene | 107-05-1 | 60 | 600 | 3 | ALDRICH | 97% |
| 1,1-Dichloroethene | 75-35-4 | 40 | 400 | 2 | SUPELCO | >99% |
| Acrolein | 107-02-8 | 200 | 2000 | 10 | CHEM SERV | 97% |
| Acrylonitrile | 107-13-1 | 100 | 1000 | 5 | CHEM SERV | >99% |
| Methylene chloride | 75-09-2 | 40 | 400 | 2 | SUPELCO | >99% |
| cis-1,2-Dichloroethene | 156-59-4 | 40 | 400 | 2 | ALDRICH | 97% |
| trans-1,2-Dichloroethene | 156-60-5 | 40 | 400 | 2 | SUPELCO | >99% |
| 1,1-Dichloroethane | 75-34-3 | 40 | 400 | 2 | SUPELCO | >99% |
| Hexane | 110-65-3 | 40 | 400 | 3 | ALDRICH | >95% |
| Chloroform | 67-66-3 | 60 | 600 | 2 | SUPELCO | >99% |
| 1,1,1-Trichloroethane | 71-55-6 | 40 | 400 | 2 | SUPELCO | >99% |
| 1,2-Dichloroethane | 107-06-2 | 40 | 400 | 2 | SUPELCO | >99% |
| Carbon tetrachloride | 56-23-5 | 40 | 400 | 2 | SUPELCO | >99% |
| Benzene | 71-43-2 | 40 | 400 | 2 | SUPELCO | >99% |
| 1,2-Dichloropropane | 78-87-5 | 40 | 400 | 2 | SUPELCO | >99% |
| Trichloroethene | 79-01-6 | 40 | 400 | 2 | SUPELCO | >99% |
| Bromodichloromethane | 75-27-4 | 60 | 600 | 3 | SUPELCO | >99% |
| 2-Chloroethylvinyl ether | 111-27-3 | 40 | 400 | 2 | SUPELCO | >99% |
| cis-1,3-Dichloropropene | 10061-01-5 | 40 | 400 | 2 | SUPELCO | >99% |
| Toluene | 10-88-3 | 40 | 400 | 2 | SUPELCO | >99% |
| trans-1,3-Dichloropropene | 10061-02-6 | 40 | 400 | 2 | SUPELCO | >99% |
| 1,1,2-Trichloroethane | 79-00-5 | 40 | 400 | 2 | SUPELCO | >99% |
| 1-Octene | 111-66-0 | 60 | 600 | 3 | ALDRICH | 97% |
| Dibromochloromethane | 124-48-1 | 40 | 400 | 2 | SUPELCO | >99% |
| Tetrachloroethene | 127-18-4 | 40 | 400 | 2 | SUPELCO | >99% |
| Chlorobenzene | 108-90-7 | 40 | 400 | 2 | SUPELCO | >99% |
| Ethylbenzene | 100-41-4 | 40 | 400 | 2 | SUPELCO | >99% |
| Styrene | 100-42-5 | 60 | 600 | 3 | ALDRICH | 99% |
| 1,3 -Dimethyl-benzene | 95-47-6 | 40 | 400 | 2 | ALDRICH | >99% |
| 1,4 -Dimethyl-benzene | 108-38-3 | 40 | 400 | 2 | ALDRICH | 97% |
| 1,2-Dimethyl-benzene | 106-42-3 | 40 | 400 | 2 | ALDRICH | 97% |
| Hexanol | 110-75-8 | 5000 | 50000 | 400 | ALDRICH | 98% |
| Bromoform | 75-25-2 | 60 | 600 | 3 | SUPELCO | >99% |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 40 | 400 | 2 | SUPELCO | >99% |
| Benzyl chloride | 100-44-7 | 60 | 600 | 3 | ALDRICH | 97% |
| 3-Chloro-toluene | 108-41-8 | 60 | 600 | 3 | ALDRICH | 98% |
| 1,3-Dichlorobenzene | 54-17-3 | 40 | 400 | 2 | ALDRICH | 98% |
| 1,4-Dichlorobenzene | 106-46-7 | 40 | 400 | 2 | ALDRICH | >99% |
| 1,2-Dichlorobenzene | 95-50-1 | 40 | 400 | 2 | ALDRICH | >99% |
| Bromodichlorobenzene | 1435-50-3 | 60 | 600 | 3 | CHEM SERV | >97% |

Table 2.2.1

FInal effluent and raw sewage samples were diluted to 5 mL using 'organic free' water. Sludges were extracted in methanol and 10 uL of the methanol extract was introduced into 5 mL of 'organic free' water and processed.

The following difficulties were encountered in the analysis of this parameter :

1) Matrix Interference

Raw sewage samples often produced foaming during purging. The foaming, if not controlled, could easily produce overloading of the GC column and result in significant background interferences. The 0.15 mL being sparged for raw sewage samples allowed a foam free operation while being able to maintain the required detection limits.

2) Instrument Sensitivity

Overall instrument sensitivity was adequate, although the NUTECH was less responsive to the early eluting volatiles eg. vinyl chloride, chloromethane, etc. Compounds such as acrylonitrile proved to be totally unresponsive, probably due to their solubility in water. Neither sparging system was equipped with the capacity to heat the sparging vessel which could improve its' ability to transfer water soluble volatiles to the GC/MS system.

3) Background Interference

Background interference was another area of concern. Even though the instrumentation was kept isolated from extraction areas, the very nature of laboratory solvents made it difficult to provide background-free traces. Compounds such as methylene chloride and benzene, and to a lesser extent toluene, chloroform and hexane, were often present in method blanks (Table 2.2.3.3.2). All data were background-corrected but this did not preclude the possibility of

spurious, radom contamination of individual samples. "False positives" could be greatly magnified when dealing with sludge samples since only 10 uL of sample was analyzed. The Hewlett-Packard MSD was restricted to approximately 10 uL of methanol since greater volumes produced pressure failures in the MS source.

### 2.2.2 Instrument Calibration

Either the NUTECH 8522 or the Envirochem 810 was used for the analysis of VOA. The instrument was tuned daily using perfluorotributylamine (FC 43) prior to any analysis. The spectrum of FC 43 was checked to ensure instrument sensitivity and correct mass calibration. Subsequently, 50 ng of p-Bromofluorobenzene (BFB) was injected and the reproducibility of tuning was checked by meeting the abundance criteria set by EPA before proceeding with any analysis. Three points (4, 10, 20 ug/L) or one point (10 ug/L) calibration was carried out weekly or daily respectively after tuning procedures. The linearity of the calibration curves was checked when the three points calibrations were performed. The response of the 10 ug/L calibration standard was at least 3 times greater than its Instrument Detection Limit (IDL). Absolute area counts of the 10 ug/L calibration standard from ten compounds selected by the Ministry were plotted over the analysis period (February - August, 1987). Plotted graphs are presented in Fig. 2.2.2.1-2.2.2.10 of Appendix 2.2. Among these ten compounds, five of them, namely methylene chloride, benzene, chloroform, toluene and hexane, demonstrated relatively high responses compared to the other five compounds. This was the result of background contamination which was addressed previously in the analytical method section. Although a number of responses obtained from 3-Chloro-1-propene were below the set lower control limit (LCL), they were still higher than the minimum sensitivity of the instrument for detecting this compound.

2.2.3 QA/QC

All QA/QC limits used as the guidelines for the evalution of the QC results presented in this report were taken from the project proposal. The limits set for each QA parameter for the analysis of volatile organics are briefly described below:

1. Surrogate Recovery

The recovery limits for the four surrogate standards d4-Dichloroethane, Bromofluorobenzene, d8-Toluene and d5-Chlorobenzene were 60-120% for the final effluent samples and 40-120% for the raw sewage, return recycle and sludge samples. The results indicated that recoveries of d4-Dichloroethane, d8-Toluene and d5-Chlorobenzene were quite consistent, but the recovery of Bromofluorobenzene was variable from sample to sample. No recovery (0%) or high recovery (>200%) of Bromofluorobenzene was noticed in a number of samples. The high variability in the recovery of Bromofluorobenzene was due to the poor purging efficiency of this very late eluting compound. The relatively low spike concentration (20 ug/L) used was another factor contributing to the inconsistent recoveries. Due to the nature of the compounds analyzed and the extra number of surrogate standards employed in the analysis of this parameter, the samples with poor recoveries of Bromofluorobenzene were not repeated.

2. Water Blank Spike Recovery

The recovery limits for the majority compounds from water blank spike samples were 60-120%. A recovery limit of 40-100% was set for seven compounds, i.e. chloromethane, vinyl chloride, vinyl bromide, diethyl ether, acrolein, acrylonitrile and styrene. Samples which had recoveries outside the limits were flagged, but not repeated.

3. Method Blank

The US EPA guidelines were used as the QC limits for method blank samples in this project. The concentration of any compound in the method blank was not allowed to exceed the US EPA contract required detection limit ( 5ug/L or 10ug/L) except for methylene chloride, hexane and toluene. These compounds were not allowed to exceed 25 ug/L in the method blank samples. No sample was allowed to proceed if the method blank sample, which was analyzed prior to any sample, did not meet the criteria.

A high level of methylene chloride was detected in the Feb. 12 and Mar. 8 samples. The reason for a high level of methylene chloride found on Feb. 12 blank sample was severe contamination of the system which occurred earlier. Corrective action was immediately taken, i.e. the system was thoroughly cleaned, the reagent was checked for contamination, etc. No sample was analyzed until the system was proved to be completely clean. The March 8th sample was the result of the low response obtained from the standard which was analyzed on the same day. The area counts of the standard were less than 1/3 normal. Therefore, these data were not included in the calculation of average and standard deviation. However, due to laboratory error, on three occasions (Jan. 28, July 7 and July 13) corrective actions were not taken immediately when methylene chloride or hexane content in the method blanks exceeded the limit. Samples could not be repeated since they had exceeded the holding time when the error was recognized.

Because of the unavoidable background contamination which was one of the major concerns during sample analysis, all samples were corrected for method blanks.

4. Replicates

The percentage difference between duplicates was calculated if compounds present in both samples were greater than 5 x MDL (US EPA guideline)

to evaluate the accuracy of the analytical technique. The percentage difference between duplicates was flagged if it was greater than 50% (US EPA guideline for organic analyses). However, samples were not repeated due to the nature of the compounds analyzed.

Detailed QC results in each QA parameter for VOA analysis are discussed below:

2.2.3.1 Surrogate Recovery

One uL surrogate standard mixture containing a known amount of d4-Dichloroethane, Bromofluorobenzene, d8-Toluene and d5-Chlorobenzene was spiked into each sample/blank/ spike before analysis. The concentration of each of these 4 surrogate standards in the final 5 mL sparging sample was 20 ng/mL. The percentage of surrogate standard recovery of each component was calculated according to the following formula:

$$\% \text{ SS recovery} = \frac{\text{Sample SS area count}}{\text{Av. SS area count from all samples, stds, etc. of the same analytical run}} \times 100$$

where: SS= Surrogate Standard, d4-dichloroethane, bromofluorobenzene, d8-toluene or d5-chlorobenzene

Each surrogate standard recovery from each sample/blank/spike was calculated and tabulated. Detailed results are documented in Appendix 2.2 (Tables 2.2.3.1.1 to 2.2.3.1.7 ) and all data points were also plotted and presented in Fig. 2.2.3.1.1 to 2.2.3.1.28 of the same Appendix. Recovery results from different sample matrices, blanks and native spike samples are summarized in the Table 2.2.3.1.8. Recoveries outside the project QA/QC limits were highlighted. All

results were screened for outliers by the Box-Whisker method ( see Appendix 2.2.1 for method description, see Fig.2.2.3.1.29 to 2.2.3.1.1.42 for detailed results). Outliers were flagged and not included in the calculation of the average recovery and standard deviation.

Recovery data were grouped according to the different sample streams: primary final effluent, secondary final effluent, raw sewage, sludge and return recycle (Appendix 2.2, Tables 2.2.3.1.1 t o 2.2.3.1.5). Among the 5 types of sample matrices analyzed, the majority of the recoveries of d4-dichloroethane (90.1%), d8-toluene (94.7%) and d5-chlorobenzene (97%) were within the project QA/QC limits. The recoveries of bromofluorobenzene were inconsistent throughout the project. This issue was addressed in an earlier section of the report (2.2.3) 18.4% of the recovery data points from this surrogate standard were outside the QA/QC limits. When each individual matrix was assessed, recoveries of all 4 surrogate standards from sludge and return recycle samples had a higher number of results (8.5% to 22.7%) outside the QA/QC limits than the other three types (0% to 19.3%).

Overall, the average recoveries of all 4 surrogate standards were quite similar to one another ( 92.9% to 104%), although recoveries from sludge (100.4%-104%) and return recycle (98.9% to 103.1%) samples were slightly higher than the other 3 types of matrices (92.9% to 99.7%) (Table 2.2.3.1.8). A students' t-test ( see Appendix 2.2.2 for definition) was performed on these 5 groups of data to evaluate the recovery efficiency due to the effect of the different sample matrices. Detailed results on the statistical analyses are presented in Appendix 2.2, Tables 2.2.3.1.9 to 2.2.3.1.48. The following conclusions were revealed by the statistical tests:

**ZENON ENVIRONMENTAL INC.**

**VOLATILE ORGANIC COMPOUND- SURROGATE RECOVERY SUMMARY FROM DIFFERENT SAMPLE STREAMS**

Project ID: AN873095 Analyst OC/MM

Instrument GC/MS Analysis Date Feb-Aug /1987

| Sample Stream Type | d4-Dichloroethane | | | | Bromofluorobenzene | | | | d8-Toluene | | | | d5-Chlorobenzene | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av % Rec. | SD | No averaged | No rejected | Av % Rec. | SD | No averaged | No rejected | Av % Rec. | SD | No averaged | No rejected | Av % Rec. | SD | No averaged | No rejected |
| Primary Final Effluent | 97 | 12 | 35 | 1 | 92 | 15 | 33 | 3 | 95 | 13 | 36 | 0 | 93 | 16 | 36 | 0 |
| Secondary Final Effluent | 96 | 16 | 225 | 8 | 97 | 16 | 205 | 28 | 94 | 12 | 222 | 11 | 96 | 16 | 225 | 8 |
| Return Recycle | 103 | 18 | 43 | 1 | 99 | 17 | 37 | 7 | 100 | 11 | 42 | 2 | 102 | 11 | 41 | 3 |
| Raw Sewage | 100 | 14 | 212 | 5 | 99 | 16 | 194 | 23 | 100 | 10 | 213 | 4 | 99 | 14 | 208 | 9 |
| Sludge | 104 | 12 | 87 | 7 | 100 | 18 | 83 | 11 | 103 | 11 | 93 | 1 | 103 | 13 | 88 | 6 |
| Water Spike | 99 | 10 | 26 | 2 | 101 | 13 | 25 | 3 | 98 | 11 | 24 | 4 | 100 | 13 | 28 | 0 |
| Method Blank | 102 | 14 | 65 | 8 | 96 | 31 | 64 | 9 | 98 | 16 | 66 | 7 | 95 | 20 | 69 | 4 |

Table 2.2.3.1.8

1. There was a significantly higher recovery of all 4 surrogate standards from sludge samples than the primary ( $p<0.05$ or 0.01) and secondary ($p<0.1$ or 0.01) final effluent samples (Tables 2.2.3.1.11, 2.2.3.1.13, 2.2.3.1.20, 2.2.3.1.24, 2.2.3.1.29, 2.2.3.1.34, 2.2.3.1.40 & 2.2.3.1.44).
2. All 4 surrogate standards recoveries from return recycle samples were significantly higher ($p<0.01$ or 0.1) than primary final effluent samples (Tables 2.2.3.1.12, 2.2.3.1.19, 2.2.3.1.30 & 2.2.3.1.39).
3. Recoveries of 3 surrogate standards, i.e. d4-dichloroethane, d8-toluene and d5-chlorobenzene, from raw sewage and return recycle samples were significantly higher ($p< 0.1$ or 0.01) than secondary final effluent samples (Tables 2.2.3.1.14, 2.2.3.1.15,2.2.3.1.23, 2.2.3.1.25, 2.2.3.1.33 & 2.2.3.1.35).
4. Similarily, recoveries of d4-dichloroethane, d8-toluene and d5-chlorobenzene from sludge samples were significantly higher ($p<0.05$ or 0.1) than raw sewage samples (Tables 2.2.3.1.16, 2.2.3.1.28 &2.2.3.1.38).
5. Sludge samples had significantly higher ($p<0.05$ or 0.01) recoveries of 3 surrogate standards, i.e. d8-toluene, bromofluorobenzene and d5-chlorobenzene than primary final effluent samples (Tables 2.2.3.1.20, 2.2.3.1.29 & 2.2.3.1.40).

The above observations indicate that volatile surrogate standards were more completely recovered from sludge/raw sewage/ return recycle samples which contained more solids than final effluent samples. An alternate explanation for the higher results may be contributed to the quantitation ions from a higher sample background.

The recoveries for the 4 volatile surrogate standards from the method blank samples are tabulated in Table 2.2.3.1.6 and also graphically shown in Fig. 2.2.3.1.25 to 2.2.3.1.28 of the Appendix 2.2. The average recovery for the 4 standards was between 94.9% and 102.1%. These recovery figures were comparable to the recoveries obtained from real samples.

Surrogate standard recoveries from water spike samples which were carried out by spiking a known amount of standard mixture containing most target compounds into a reagent water blank sample are presented in Table 2.2.3. 1.7 and Fig.2.2.3.1.21 to 2.2.3.1.24. The average recovery was between 99% and 101%. These values were also comparable to the recoveries obtained from true samples.

2.2.3.2 Water Spike Recovery

A known amount of standard mixture containing selected target compounds was spiked into a reagent water blank sample. The concentration of each compound in the mixture was 200 ug/L. The percentage recovery of individual compound in the mixture was calculated using the following formula:

$$\begin{array}{l} \text{\% Recovery} \\ \text{of compd A} \end{array} = \left( \frac{\text{Spike A area count - method blk. A area count}}{\text{Std. A area count - method blk. A area count}} \times \text{Std.A conc.} \right)$$

$$/ \text{ Spike A amt. added} \times 100\%$$

The recovery results from 28 of these spiked samples are individually presented in Appendix 2.2 (Tables 2.2.3.2.1-2.2.3.2.28 ) and summarized in Table 2.2.3.2.29. Results of ten compounds , e.g. chloroform,1,1,1-trichloroethane, methylene chloride, hexane, benzene, ethylbenzene, toluene, 1,3 & 1,4-dimethylbenzene, 1,2-dimethylbenzene & 3-chloro-1-propene, ( chosen by the Ministry) are also graphically presented in Fig.2.2.3.2.1 & 2.2.3.2.10 of Appendix 2.2. Recoveries outside the project QA/QC limits are highlighted and all data were also checked for outliers by the Box-Whisker method. ( see Appendix 2.2 for method description and see Fig. 2.2.3.2.11- 2.2.3.2.27 for detailed results) Compounds which had recoveries outside the QA/QC limits were not repeated.

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095    Analyst: TMC

Instrument: GC/MS    Analysis Date: Feb.-Aug./87

Matrix Type: Water Blank

| Parameter | Feb.17 | Feb.25 | Feb.26 | Feb.27 | Feb.28 | Mar. 2 | Mar. 5 | Mar. 9 | Mar. 10 | Mar. 18 |
|---|---|---|---|---|---|---|---|---|---|---|
| Chloromethane | | 208 % | 38 % | 156 % | 91 % | | 56 % | | | 38 % |
| Dichlorodifluoromethane | | 82 % | 32 % | 33 % | 46 % | | 96 % | | | |
| Vinyl Chloride | | | | | | | | | | 74 % |
| Vinyl bromide | | 96 % | 53 % | 54 % | | | 51 % | | | 53 % |
| Chloroethane | | | | | | | | 105 % | 128 % | 81 % |
| Diethyl ether | | 120 % | 83 % | 74 % | 69 % | | 135 % | 106 % | 149 % | 74 % |
| Trichlorofluoromethane | | 135 % | 67 % | | | | 63 % | 63 % | 133 % | 74 % |
| Bromoethane | 90 % | 108 % | 75 % | 62 % | 73 % | 64 % | 77 % | 97 % | 82 % | 80 % |
| 3-Chloro-1-propene | 77 % | 107 % | 78 % | 70 % | 91 % | 95 % | 76 % | 86 % | 95 % | 74 % |
| 1,1-Dichloroethene | 32 % | 126 % | 107 % | 70 % | 88 % | 75 % | 59 % | 55 % | 100 % | 77 % |
| Methylene chloride | 121 % | 91 % | 103 % | 49 % | 68 % | 74 % | 68 % | 115 % | 105 % | 53 % |
| cis-1,2-Dichloroethene | | | 111 % | 88 % | 77 % | 84 % | 49 % | 63 % | 107 % | 84 % |
| trans-1,2-Dichloroethene | 50 % | 139 % | | | | | | | | 99 % |
| 1,1-Dichloroethane | 64 % | 119 % | 154 % | 93 % | 96 % | 108 % | 65 % | 46 % | 101 % | 87 % |
| Hexane | 84 % | 116 % | 108 % | 90 % | 94 % | 76 % | 151 % | 83 % | 71 % | 38 % |
| Chloroform | 77 % | 99 % | 112 % | 89 % | 94 % | 89 % | 67 % | 80 % | 65 % | 64 % |
| 1,1,1-Trichloroethane | 72 % | 134 % | 101 % | 56 % | 72 % | 85 % | 70 % | 43 % | 102 % | 76 % |
| 1,2-Dichloroethane | 76 % | 99 % | 92 % | 59 % | 70 % | 66 % | 69 % | 44 % | 104 % | 83 % |
| Carbon tetrachloride | 64 % | 122 % | 111 % | 59 % | 73 % | 74 % | 70 % | 50 % | 101 % | |
| Benzene | 55 % | 98 % | 113 % | 76 % | 73 % | 71 % | 64 % | 63 % | 64 % | |
| 1,2-Dichloropropane | 76 % | 83 % | 109 % | 84 % | 106 % | 50 % | 110 % | 42 % | 69 % | 76 % |
| Trichloroethene | 71 % | 125 % | 107 % | 75 % | 75 % | 84 % | 85 % | **15 %#** | 86 % | 70 % |
| Dibromomethane | | | | | | | | | | |
| bis(2-Chloroethylvinyl) ether | 74 % | 79 % | 106 % | 80 % | 115 % | | 84 % | 77 % | 125 % | 61 % |
| Bromodichloromethane | 79 % | 96 % | 115 % | 67 % | 94 % | 97 % | 93 % | 43 % | 98 % | 60 % |
| cis-1,3-Dichloropropene | 98 % | 97 % | 113 % | 75 % | 88 % | | 89 % | 36 % | 93 % | 81 % |
| Toluene | 83 % | 98 % | 97 % | 79 % | 74 % | 86 % | 85 % | 48 % | 84 % | 70 % |
| trans-1,3-Dichloropropene | 116 % | 93 % | 111 % | 106 % | 73 % | 117 % | 73 % | | | 84 % |
| 1,2-Dibromoethane | | | | | | 105 % | | | | |
| 1,1,2-Trichloroethane | 86 % | 72 % | 84 % | 118 % | 102 % | 68 % | 77 % | 37 % | 108 % | 80 % |
| 1-Octene | 96 % | 112 % | 63 % | 89 % | 85 % | 118 % | 74 % | 79 % | 87 % | 73 % |
| Dibromochloromethane | 106 % | 81 % | 100 % | 70 % | 115 % | 108 % | 102 % | **45% #** | 101 % | 85 % |
| Tetrachloroethene | 78 % | 113 % | 107 % | 77 % | 76 % | 75 % | 80 % | 43 % | 95 % | 81 % |
| Chlorobenzene | 90 % | 103 % | 102 % | 66 % | 77 % | 82 % | 78 % | 41 % | 93 % | 77 % |
| Ethylbenzene | 98 % | 113 % | 81 % | 91 % | 105 % | 89 % | 105 % | **47%#** | 107 % | 75 % |
| Styrene | | | | | | | | | | 103 % |
| 1,2 & 1,3-Dimethyl-benzene | 98 % | 114 % | 82 % | 82 % | 88 % | 84 % | 84 % | 93 % | 85 % | |
| 1,4-Dimethyl-benzene | | | 81 % | | | | 104 % | 50 % | 105 % | |
| Hexanol | | | | | | | 66 % | | | 86 % |
| Bromoform | 101 % | 94 % | 92 % | 58 % | 67 % | 64 % | 73 % | 50 % | 118 % | 85 % |
| 1,1,2,2-Tetrachloroethane | 81 % | 73 % | 91 % | 71 % | 73 % | 63 % | 76 % | 41 % | 125 % | |
| Benzyl chloride | 95 % | 104 % | 86 % | 86 % | 92 % | 73 % | 80 % | | 87 % | 80 % |
| 3-Chloro-toluene | | | | | | | | | | 83 % |
| 1,3-Dichlorobenzene | 92 % | 131 % | 114 % | 86 % | 103 % | 69 % | 114 % | **31%#** | 141 % | 74 % |
| 1,4-Dichlorobenzene | 84 % | 98 % | 120 % | 73 % | 85 % | 82 % | 104 % | **31%#** | **146%#** | 79 % |
| 1,2-Dichlorobenzene | 86 % | 82 % | 109 % | 70 % | 78 % | 69 % | 75 % | 33 % | 125 % | 110 % |
| Bromodichlorobenzene | | | | | | | | | | |

# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.2.29

ZENON ENVIRONMENTAL INC.

## VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Water Blank | | |

| Parameter | Mar. 24 | Apr. 15 | May 11 | May 12 | May.18 | May 19 | May 25 | Jun 02 | Jun 10 | Jun 17 |
|---|---|---|---|---|---|---|---|---|---|---|
| Chloromethane | | | 52% | | 86% | | 95% | | 147% | 106% |
| Dichlorodifluoromethane | 91% | 57% | 98% | | 125% | | **180% #** | 48% | 45% | 28% |
| Vinyl Chloride | **199%#** | | 63% | | 58% | | | | 58% | 20% |
| Vinyl bromide | 78 % | 92% | 123% | | 86% | | 72% | 83% | 38% | 87% |
| Chloroethane | 95% | 143% | 56% | | 84% | | | | 67% | **171%#** |
| Diethyl ether | 68% | 75% | 56% | | 127% | | 128% | 109% | 75% | 79% |
| Trichlorofluoromethane | 70% | | 61% | | 89% | | 97% | 89% | 67% | 102% |
| Bromoethane | | 90% | 35% | | 83% | | 73% | 78% | 114% | 106% |
| 3-Chloro-1-propene | **248%#** | 80% | 50% | | 79% | | 67% | 17% | 70% | 127% |
| 1,1-Dichloroethene | 62% | 43% | 88% | | 114% | | 116% | 117% | 72% | 94% |
| Methylene chloride | 74% | 26% | 91% | 143% | **182%#** | 168% | 128% | 116% | **180%#** | 51% |
| cis-1,2-Dichloroethene | 74% | 125% | 55% | 125% | 90% | 97% | 93% | 97% | 89% | 107% |
| trans-1,2-Dichloroethene | | 83% | 41% | 111% | 83% | 100% | 52% | 80% | 126% | 72% |
| 1,1-Dichloroethane | 73% | 41% | 108% | 108% | 90% | 104% | 120% | 121% | **162%#** | 102% |
| Hexane | 56% | 48% | 60% | 112% | **199%#** | 90% | 150% | 115% | **226%#** | 88% |
| Chloroform | 84% | 56% | 64% | 120% | **184%#** | 91% | 142% | 102% | 137% | 38% |
| 1,1,1-Trichloroethane | 75% | 96% | 25% | 104% | 90% | 118% | 84% | 46% | 89% | 100% |
| 1,2-Dichloroethane | 22% | 120% | 60% | 107% | 88% | 79% | 108% | 85% | 85% | 95% |
| Carbon tetrachloride | 30% | 36% | 36% | 101% | 68% | 93% | 84% | 75% | 103% | **165%#** |
| Benzene | 45% | 74% | 61% | 131% | 183% | 116% | 142% | 121% | 119% | 29% |
| 1,2-Dichloropropane | 72% | 72% | 67% | 102% | 124% | 109% | 77% | 111% | 111% | 108% |
| Trichloroethene | 64% | 48% | 62% | 105% | 97% | 101% | 99% | 108% | 84% | 99% |
| Dibromomethane | | | 58% | 109% | 96% | | 103% | 100% | 96% | 107% |
| bis(2-Chloroethylvinyl) ether | 78% | | | 109% | | | | | 46% | |
| Bromodichloromethane | 79% | 103% | 59% | 89% | 113% | 57% | 95% | 101% | 112% | 126% |
| cis-1,3-Dichloropropene | 66% | 117% | 59% | 95% | 73% | 104% | 87% | 86% | 83% | 117% |
| Toluene | 81% | 81% | 57% | 102% | **173% #** | 103% | 113% | 127% | 118% | 59% |
| trans-1,3-Dichloropropene | 70% | 145% | 68% | 89% | | 113% | 95% | 115% | 71% | 153% |
| 1,2-Dibromoethane | | | 112% | 108% | 61% | | 59% | **252%#** | 81% | 105% |
| 1,1,2-Trichloroethane | 77% | **165%#** | 94% | 106% | 57% | 121% | 45% | 75% | 105% | 103% |
| 1-Octene | 153% | 50% | 114% | 101% | 93% | | 88% | **194%#** | 72% | 143% |
| Dibromochloromethane | **42%#** | 64% | 121% | 95% | 83% | 109% | 84% | 127% | 111% | 101% |
| Tetrachloroethene | 67% | 63% | 107% | 95% | 69% | 119% | 95% | 124% | 112% | 91% |
| Chlorobenzene | 84% | 76% | 61% | 98% | 95% | 107% | 90% | 105% | 74% | 106% |
| Ethylbenzene | 70% | 93% | 59% | 94% | 99% | 100% | 98% | 108% | 81% | 98% |
| Styrene | 87% | 83% | 61% | 98% | 80% | 106% | 85% | 106% | 85% | 105% |
| 1,2 & 1,3-Dimethyl-benzene | 91% | 74% | 61% | 97% | 108% | 104% | 98% | 111% | 81% | 130% |
| 1,4-Dimethyl-benzene | | 77% | 59% | 96% | 108% | 102% | 98% | 115% | 78% | 132% |
| Hexanol | | | | 45% | | | | | | |
| Bromoform | 64% | 106% | 68% | 85% | 81% | 118% | 103% | 76% | 51% | 112% |
| 1,1,2,2-Tetrachloroethane | 64% | 40% | 68% | 99% | 78% | 113% | 98% | 94% | 63% | 65% |
| Benzyl chloride | | | 71% | 96% | | 98% | | | | |
| 3-Chloro-toluene | 94% | 70% | **62%#** | 90% | 88% | 99% | 90% | 105% | 91% | 93% |
| 1,3-Dichlorobenzene | | 61% | 59% | 97% | 79% | 97% | 92% | 94% | 92% | 103% |
| 1,4-Dichlorobenzene | | 56% | 63% | 97% | 101% | 100% | 100% | 97% | 120% | 84% |
| 1,2-Dichlorobenzene | | 59% | 62% | 96% | 36% | 101% | 99% | 85% | 93% | 105% |
| Bromodichlorobenzene | | 54% | 73% | | | | | | 99% | 114% |

# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.2.29

ZENON ENVIRONMENTAL INC.

## VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | | |
|---|---|---|---|---|
| Project ID: | AN873095 | | Analyst | TMC |
| Instrument | GC/MS | | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Water Blank | | | |

| Parameter | Jun 25 | Jun 26 | Jul 16 | Jul 27 | Aug.4 | Aug.10 | Aug.14 | Aug.17 | Average | SD | No of data averaged | No of data rejected |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloromethane | 79% | 200% | 28% | 10% | | | 30% | 40% | 86% | 60% | 17 | 0 |
| Dichlorodifluoromethane | 122% | 122% | 82% | 39% | 86% | 74% | 83% | 83% | 74% | 31% | 20 | 1 |
| Vinyl Chloride | | | 55% | 48% | 39% | 48% | | 36% | 50% | 15% | 10 | 1 |
| Vinyl bromide | 116% | 116% | 63% | 58% | 79% | 93% | 56% | 70% | 77% | 24% | 21 | 0 |
| Chloroethane | | | 70% | 40% | 100% | 41% | | 61% | 82% | 31% | 13 | 1 |
| Diethyl ether | 100% | 100% | 95% | 79% | 112% | 74% | 147% | 86% | 97% | 27% | 24 | 0 |
| Trichlorofluoromethane | 102% | 102% | 87% | 80% | 91% | 60% | 84% | 76% | 85% | 22% | 21 | 0 |
| Bromoethane | 94% | 94% | 65% | 54% | 93% | 58% | 65% | 73% | 79% | 18% | 25 | 0 |
| 3-Chloro-1-propene | **178%#** | **178%#** | 45% | 53% | 62% | 34% | 39% | 113% | 73% | 26% | 23 | 3 |
| 1,1-Dichloroethene | 98% | 98% | 77% | 74% | 96% | 71% | 77% | 79% | 84% | 23% | 26 | 0 |
| Methylene chloride | 105% | 105% | 81% | 93% | 110% | 104% | 90% | 99% | 93% | 31% | 24 | 2 |
| cis-1,2-Dichloroethene | 96% | 96% | 81% | 65% | 92% | 70% | 82% | 97% | 88% | 19% | 26 | 0 |
| trans-1,2-Dichloroethene | 105% | 105% | 72% | 71% | 78% | 67% | 31% | 82% | 82% | 28% | 20 | 0 |
| 1,1-Dichloroethane | 91% | | 86% | 67% | 103% | 61% | 93% | 99% | 92% | 25% | 27 | 0 |
| Hexane | 107% | 107% | 121% | 53% | 84% | 74% | 135% | 158% | 95% | 32% | 26 | 2 |
| Chloroform | 115% | 115% | 163% | 85% | 170% | 67% | 111% | 104% | 96% | 32% | 27 | 1 |
| 1,1,1-Trichloroethane | 108% | 108% | 111% | 76% | 103% | 77% | 110% | 109% | 87% | 24% | 28 | 0 |
| 1,2-Dichloroethane | 102% | | 87% | 79% | 97% | 81% | 113% | 100% | 84% | 22% | 27 | 0 |
| Carbon tetrachloride | 87% | 87% | 97% | 50% | 94% | 70% | 117% | 99% | 79% | 25% | 27 | 0 |
| Benzene | 116% | 116% | 152% | 83% | 212% | 88% | 144% | 125% | 101% | 43% | 26 | 1 |
| 1,2-Dichloropropane | 124% | | 101% | 84% | 115% | 86% | 111% | 88% | 91% | 22% | 27 | 0 |
| Trichloroethene | 120% | 120% | 107% | 79% | 107% | 82% | 88% | 84% | 90% | 19% | 26 | 1 |
| Dibromomethane | 111% | 111% | 84% | 79% | 93% | 86% | 91% | 83% | 94% | 14% | 15 | 0 |
| bis(2-Chloroethylvinyl) eth | 79% | 79% | | 65% | | 91% | **169%#** | 75% | 84% | 20% | 16 | 1 |
| Bromodichloromethane | 41% | 41% | 87% | 82% | 89% | 90% | 107% | 85% | 86% | 23% | 28 | 0 |
| cis-1,3-Dichloropropene | 113% | | 94% | 81% | 97% | 68% | 87% | 77% | 87% | 19% | 26 | 0 |
| Toluene | 121% | 121% | 144% | 89% | 101% | 81% | 106% | 93% | 93% | 23% | 27 | 1 |
| trans-1,3-Dichloropropene | 109% | | 79% | 87% | 86% | 52% | **206%#** | 96% | 96% | 25% | 23 | 1 |
| 1,2-Dibromoethane | 102% | 102% | 52% | 93% | 93% | 86% | 91% | 90% | 89% | 19% | 14 | 1 |
| 1,1,2-Trichloroethane | 92% | 92% | 74% | 88% | 102% | 89% | **28%#** | 70% | 85% | 21% | 26 | 2 |
| 1-Octene | | | 37% | 83% | 117% | 80% | 79% | 92% | 91% | 26% | 24 | 1 |
| Dibromochloromethane | 101% | 101% | 90% | 86% | 95% | 96% | 94% | 88% | 97% | 15% | 26 | 2 |
| Tetrachloroethene | 124% | 124% | | 85% | 86% | 84% | 94% | 82% | 91% | 20% | 27 | 0 |
| Chlorobenzene | 106% | 106% | 92% | 93% | 107% | 82% | 78% | 106% | 88% | 16% | 28 | 0 |
| Ethylbenzene | 101% | 104% | 104% | 98% | 92% | 73% | 114% | 104% | 95% | 13% | 27 | 1 |
| Styrene | 98% | 98% | 86% | 105% | 86% | 83% | 97% | 85% | 91% | 12% | 19 | 0 |
| 1,2 & 1,3-Dimethyl-benzer | 111% | 118% | | 98% | 103% | 69% | 82% | 95% | 94% | 16% | 26 | 0 |
| 1,4-Dimethyl-benzene | 107% | 117% | | 95% | 86% | 119% | 97% | 80% | 95% | 20% | 20 | 0 |
| Hexanol | | | | | | | | | 66% | 20% | 3 | 0 |
| Bromoform | 86% | 86% | 59% | 97% | 90% | 76% | 99% | 67% | 83% | 19% | 28 | 0 |
| 1,1,2,2-Tetrachloroethane | 86% | 86% | 84% | 95% | 91% | 77% | 104% | 73% | 80% | 19% | 27 | 0 |
| Benzyl chloride | 93% | 93% | | | **16%#** | 42% | **16 %#** | 62% | 84% | 16% | 16 | 2 |
| 3-Chloro-toluene | 95% | 95% | 96% | 99% | 96% | 79% | 86% | 71% | 90% | 9% | 18 | 1 |
| 1,3-Dichlorobenzene | 89% | 89% | 77% | 99% | 105% | 81% | 77% | 54% | 91% | 21% | 26 | 1 |
| 1,4-Dichlorobenzene | 95% | 95% | 74% | 103% | 110% | 85% | 84% | 81% | 91% | 16% | 25 | 2 |
| 1,2-Dichlorobenzene | 77% | 77% | 56% | 108% | **285 %#** | 77% | 106% | 90% | 83% | 23% | 26 | 1 |
| Bromodichlorobenzene | 94% | 94% | 83% | 88% | 87% | 86% | 84% | **44 %#** | 87% | 15% | 11 | 1 |

# outlier, not included in the calulation of average and standard deviation

Table 2.2.3.2.29

The average recoveries of all compounds tested were all within the project recovery limits (60-120% or 40-100%). (Appendix 2.2, Table 2.2.3.2.29) Among the 47 compounds detected, vinyl chloride had the lowest average recovery (50%), while benzene had the highest (101%). Among the 28 samples analyzed, 5 compounds (namely Chloromethane, Dichlorodifluoromethane, 1,1-Dichloroethane, 1,1,1-Trichloroethane and Carbontetrachloride ) were found to be outside their recovery ranges more frequently than other compounds.

2.2.3.3 Method Blank

A method blank was analyzed along with each batch of samples to identify possible contamination contributed by glassware, reagents, other samples etc. Seventy -three method blank samples were analyzed during the current project and the results are tabulated in Table 2.2.3.3.1 of Appendix 2.2.

Methylene chloride, chloroform, toluene, benzene and hexane were the 5 most frequent compounds detected in the method blanks. A summary of their frequency occurrence is presented in Table 2.2.3.3.2. Results indicated that methylene chloride was found in 90% of the blank samples. The concentration distributions of these 5 compounds in the method blanks were graphically presented in Fig. 2.2.3.3.1 to 2.2.3.3.5 of Appendix 2.2..

2.2.3.4 Replicates

Twenty-four pairs of samples (4-SL, 14-FE, 6-RS) were analyzed as laboratory duplicates: i.e. two aliquots were taken from a single sample and carried through the same analytical process. Duplicate analyses provide a measure of analysis variability. The percentage difference between duplicates was calculated if concentrations in both duplicates were greater than 5 x MDL. The formula for calculating the percentage of difference between duplicates is:

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND- METHOD BLANK SUMMARY
(COMPOUNDS FREQUENTLY FOUND IN THE METHOD BLANKS)



| | Compound (ug/L) | | | | |
|---|---|---|---|---|---|
| | Methylene Chloride | Chloroform | Benzene | Toluene | Hexane |
| Average | 9 | 3 | 4 | 3 | 7 |
| S.D. | 6 | 3 | 3 | 5 | 11 |
| Frequency* | 90.4 % | 39.7 % | 58.9 % | 57.5 % | 54.8 % |

* times being detected/number of analyses x100%

Table 2.2.3.3.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Mar.-Sept.87 |
| Matrix Type (FE-final effluent,RS-raw sewage,SL-sludge) | RS | | |

| Zenon Sample ID | Methylene Chloride (ug/L) | % Difference | 1,1,1-Trichloroethane (ug/L) | % Difference |
|---|---|---|---|---|
| ZE12-21 | (1) 98<br>(2) 110 | **11.5%** | (1) 290<br>(2) 350 | **18.8%** |
| ZE13-25 | | | (1) 360<br>(2) 96 | **115 % *** |
| ZE18-22 | | | | |
| ZE21-29 | | | | |
| ZE24-11 | | | | |
| ZE27-10 | | | | |

* outside the QA/QC limit
Blank areas indicate compounds were not detected
% diff. = percentage difference between the duplicate samples, only calculated if both samples were > 5 x MDL

Table 2.2.3.4.1

**ZENON ENVIRONMENTAL INC.**

**VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY**

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Mar.-Sept.87 |

Matrix Type (FE-final effluent,RS-raw sewage,SL-slud SL

| Zenon Sample ID | Methylene Chloride (ug/L) | % Difference | Hexane (ug/L) | % Difference | Toluene (ug/L) | % Difference | 1,3&1,4-dimethylbenzene (ug/L) | % Difference |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| ZE07-0019 | | | | | | | | |
| | | | 750 | | | | | |
| ZE22-0051 | | | | | | | | |
| | | | | | 7700 | | 470 | |
| ZE30-0007 | | | | | 6700 | **14%** | 340 | **32%** |
| | 1800 | | | | | | | |
| ZE31-0046 | 1500 | **18%** | | | | | | |

Blank areas indicate compounds were not detected
% diff. = percentage difference between the uplicate samples, only calculated if both samples were > 5 X MDL

Table 2.2.3.4.2

ZENON ENVIRONMENTAL INC.

## VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY

Project ID: AN873095 | Analyst: TC

Instrument: GC/MS | Analysis Date: Mar.-Sept.87

Matrix Type (FE-final effluent,RS-raw sewage,SL-sludge): FE

| PARAMETERS | ZE 04-0029 | % Diff. | ZE 08-0025 | % Diff. | ZE 09-0041 | % Diff. | ZE 11-0032 | % Diff. | ZE 12-0020 | % Diff. | ZE 13-0020 | % Diff. | ZE 13-0033 | % Diff. | ZE 15-0002 | % Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | | | | | | | | | | | | | | | | |
| Methylene chloride | | | (1) 13<br>(2) 2 | | | | (1) 2.7 | | (1) 8.7 | | | | | | (1) 29<br>(2) 19 | 42% |
| cis-1,2-Dichloroethene | | | | | | | | | | | | | | | | |
| 1,1-Dichloroethane | | | | | (1) 26<br>(2) 23 | 12% | | | | | | | | | | |
| Hexane | | | | | | | (1) 7.4 | | | | (1) 4.8<br>(2) 5 | | | | (1) 3 | |
| Chloroform | (1) 3.1<br>(2) 2.9 | | (2) 6.3 | | (1) 46<br>(2) 42 | 9% | | | (1) 3.2 | | (2) 17 | | | | (1) 16<br>(2) 11 | 37% |
| Benzene | | | (2) 7.1 | | | | | | | | | | (1) 2.8<br>(2) 2.8 | | | |
| 1,1,1-Trichloroethane | | | | | (1) 26<br>(2) 23 | 12% | (1) 4.1<br>(2) 3 | | (1) 23<br>(2) 17 | 30% | | | | | (1) 5.9 | |
| 1,2-Dichloroethane | | | | | | | | | | | | | | | | |
| Carbon tetrachloride | | | | | | | | | | | | | | | (1) 17<br>(1) 17 | 0% |
| 1,2-Dichloropropane | | | | | (1) 13<br>(2) 12 | 8% | | | | | | | | | | |
| Trichloroethene | | | (1) 7.6<br>(2) 7.4 | | | | | | | | | | | | | |
| Bromodi-chloromethane | | | | | (1) 21<br>(2) 21 | 0% | | | | | | | | | | |
| cis-1,3-Dichloro-propene | | | | | (1) 3.2<br>(2) 3 | | | | | | | | | | | |
| trans-1,3-Dichloro-propene | | | | | (1) 2<br>(2) 3.2 | | | | | | | | | | | |

Table 2.2.3.4.3 a

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY

Project ID: AN873095 | Analyst: TC

Instrument: GC/MS | Analysis Date: Mar.-Sept.87

Matrix Type (FE-final effluent,RS-raw sewage,SL-sludge): FE

| PARAMETERS | ZE 04-0029 | % Diff. | ZE 08-0025 | % Diff. | ZE 09-0041 | % Diff. | ZE 11-0032 | % Diff. | ZE 12-0020 | % Diff. | ZE 13-0020 | % Diff. | ZE 13-0033 | % Diff. | ZE 15-0002 | % Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,2-Trichloroethane | | | | | | | | | | | | | | | | |
| Toluene | | | (1) 27<br>(2) 79 | 98% * | | | | | | | | | | | (1) 5.2<br>(2) 2.3 | |
| Tetrachloroethene | | | (1) 380<br>(2) 358 | 6% | (1) 19<br>(2) 16 | 17% | | | | | | | | | (1) 4.2<br>(2) 2.5 | |
| Ethylbenzene | | | (1) 6.8<br>(2) 11 | | | | | | | | | | | | | |
| 1,3 & 1,4-Dimethyl-benzene | | | (1) 15<br>(2) 50 | 108%* | | | | | | | | | | | | |
| 1, 2-Dimethylbenzene | | | (1) 15<br>(2) 23 | 42% | | | | | | | | | | | (2) 3.3 | |
| Bromoform | | | | | (1) 31<br>(2) 31 | 0% | | | | | | | | | | |
| 1,1,2,2-Tetra-chloroethane | | | | | | | | | | | | | | | | |
| 3-Chloro-toluene | | | | | | | | | | | | | | | | |
| 1,3-Dichlorobenzene | | | | | | | | | | | | | | | | |
| 1, 4-Dichlorobenzene | | | | | | | | | | | | | | | | |
| 1,2-Dichlorobenzene | | | | | | | | | | | | | | | | |

* outside the QA/QC limit
Blank areas indicate compounds were not detected
% diff.= percentage difference between the duplicate samples, only calculated if both samples were > 5 x MDL

Table 2.2.3.4.3 a

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY

Project ID: AN873095 | Analyst: TC

Instrument: GC/MS | Analysis Date: Mar.-Sept.87

Matrix Type (FE-final effluent,RS-raw sewage,SL-sludge): FE

| PARAMETERS | ZE 17-0002 | % Diff. | ZE 20-0002 | % Diff. | ZE 22-0030 | % Diff. | ZE 23-0034 | % Diff. | ZE 27-0003 | % Diff. | ZE 29-0004 | % Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | (1) 2.3<br>(2) 2.7 | | | | | | | | | | | |
| Methylene chloride | (1) 3.7 | | | | | | | | | | | |
| cis-1,2-Dichloroethene | (1) 24<br>(2) 23 | **4%** | | | | | | | | | | |
| 1,1-Dichloroethane | | | | | | | | | | | | |
| Hexane | | | | | | | | | | | (1) 4.1 | |
| Chloroform | | | | | | | | | | | | |
| Benzene | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | (1) 16<br>(2) 19 | **17%** | (1) 160<br>(2) 100 | **46%** | | | | | | | | |
| 1,2-Dichloroethane | (1) 13<br>(2) 16 | **21%** | | | | | | | | | | |
| Carbon tetrachloride | | | (2) 16 | | | | | | | | | |
| 1,2-Dichloropropane | | | | | | | | | | | | |
| Trichloroethene | | | | | | | | | | | | |
| Bromodi-chloromethane | (1) 14<br>(2) 13 | **7%** | | | | | | | | | | |
| cis-1,3-Dichloro-propene | | | | | | | | | | | | |
| trans-1,3-Dichloro-propene | (1) 3.8<br>(2) 4.4 | | | | | | | | | | | |

Table 2.2.3.4.3 b

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND- REPLICATE ANALYSIS SUMMARY

Project ID: AN873095

Analyst: TC

Instrument: GC/MS

Analysis Date: Mar.-Sept.87

Matrix Type (FE-final effluent,RS-raw sewage,SL-sludge): FE

| PARAMETERS | ZE 17-0002 | % Diff. | ZE 20-0002 | % Diff. | ZE 22-0030 | % Diff. | ZE 23-0034 | % Diff. | ZE 27-0003 | % Diff. | ZE 29-0004 | % Diff. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,2-Trichloroethane | (1) 16<br>(2) 17 | 6% | | | | | | | | | | |
| Toluene | (1) 3.5<br>(2) 4.2 | | | | | | | | | | | |
| Tetrachloroethene | | | (2) 5.8 | | | | | | | | | |
| Ethylbenzene | (1) 9.3<br>(2) 10 | 7% | | | | | | | | | | |
| 1,3 & 1,4-Dimethyl-benzene | | | | | | | (2) 2.9 | | | | | |
| 1, 2-Dimethylbenzene | | | | | | | (1) 2.8<br>(2) 3.6 | | | | | |
| Bromoform | (1)11<br>(2)12 | | | | | | | | | | | |
| 1,1,2,2-Tetra- | (2)11 | | | | | | | | | | | |
| 3-Chloro-toluene | (1) 2.8 | | | | | | | | | | | |
| 1,3-Dichlorobenzene | (1) 3.9 | | | | | | | | | | | |
| 1, 4-Dichlorobenzene | (1) 5 | | | | | | | | | | | |
| 1,2-Dichlorobenzene | (1) 4 | | | | | | | | | | | |

* outside the QA/QC limit
Blank areas indicate compounds were not detected
% diff. = percentage difference between the duplicate samples, only calculated if both samples were > 5 x MDL

Table 2.2.3.4.3 b

$$\text{Percentage difference} = \frac{\text{conc. in analysis 1 - conc. in analysis 2}}{(\text{conc. in analysis 1+conc. in analysis 2})/2} \times 100\%$$

Results were flagged but not reanalysed if the difference between duplicates was greater than 50%. Among the 24 pairs of duplicate samples analyzed for VOA from MISA STP-40 program , only 9.4% ( 106 out of 1128 data points) positive results were observed. Out of 106 positive data points, only 56 ( 28 pairs) results were 5 times greater than the compound's MDL. Therefore, the percentage difference between duplicates was only calculated for these 28 pairs of results. A summarized table for each matrix is tabulated and presented in Table 2.2.3.4.1 to 2.2.3.4.3. There were 3 pairs of results ( 1 from raw sewage and 2 from final effluent) which gave a percentage difference between duplicates greater than 50% and they were highlighted.

Because of the limited positive results obtained from raw sewage (3 pairs) and sludge (3 pairs) duplicate samples, a conclusion on the matix effect on analytical precision can not be drawn at the present time. Futhermore, the adequacy or otherwise of a 0.15 mL sample for volatile analysis of raw sewage samples can not be established from the current limited duplicate data .

## 2.3 ORGANOCHLORINE PESTICIDES/HERBICIDES

To be provided by Enviroclean

## 2.4 Polychlorodibenzodioxins/furans (PCDD/F)

Ten congener groups were investigated in the analysis of this parameter. Eight of the congeners consisted of groups of isomers of the same compound. These groups , and the number of isomers involved in each case were:

tetrachlorodibenzodioxins ($T_4CDD$), 22 isomers

tetrachlorodibenzofurans ($T_4CDF$) , 38 isomers

pentachlorodibenzodioxins ($P_5CDD$), 14 isomers

petachlorodibenzofurans ($P_5CDF$), 28 isomers

hexachlorodibenzodioxins ($H_6CDD$), 10 isomers

hexachlorodibenzofurans ($H_6CDF$), 16 isomers

heptachlorodibenzodioxins($H_7CDD$), 2 isomers

heptachlorodibenzofurans ($H_7CDF$), 4 isomers

There were also two single congeners, namely octachlorodibenzodioxin ($O_8CDD$) and octachlorodibenzofuran ($O_8CDF$).

Because the determinations made were of the total isomers of most congeners, a list of Chemical Abstract Services (CAS ) Registry Number for all the analytes could not be provided.

Due to the complexity of the sample matrices, the method detection limits (MDL) employed in the analysis of PCDD/F were highly variable from sample to sample depending on the cleanliness, homogeneity, interference, etc. of the individual sample. Therefore, the method detection limit was established in the following manner:

The instrumental response of the low level standard was evaluated and compared to the noise level in the same standard. For each sample, the background level was evaluated and the area of peak which would provide a signal to noise level of at least three to one in that sample and for that congener group was calculated and

presented as the MDL. The MDL ranges employed in PCDD/F analysis for more than 95 % of the samples analyzed in the current project were 0.05 - 4 ng/g for sludge and return recycle samples and 0.1 - 5 ng/L for final effluent and raw sewage samples.

The standards used in this project for PCDD/F analysis were purchased from Cambridge Isotope Ltd. The purity of each individual standard was greater than 99% .

### 2.4.1 Analytical Method

Final effluents and raw sewage were measured in a 1 L graduated cylinder and transferred to 2 L separatory funnels. Surrogate spikes of 2,3,7,8 $T_4CDD$ $^{13}C_{12}$ and $O_8CDD$ $^{13}C_{12}$ were added to monitor extraction efficiency. Samples were extracted with 3 successive batches of methylene chloride and all extracts combined, dried and concentrated to a final volume of 1-2 mL. Extracts were then applied to a multi-column clean up procedure with final extracts made up to appropriate volumes with a solution of 250 pg/uL $d_{12}$-triphenylene in iso-octane.

Sludge samples were weighed first, mixed with $Na_2SO_4$ , transferred to glass thimbles, spiked with surrogates as above and extracted overnight in toluene. Extracts were concentrated and then applied to multi-column clean up as above with final volumes adjusted to 100 uL. Complete details are provided in Appendix 2.4.

Difficulties arose from two areas.

1) Sample Matrix

Sludge samples often produced significant background levels which interfered with the labelled 2,3,7,8 $T_4CDD$. The clean-up procedure was repeated in some sludge samples because of the high background interference. In some case, samples were repeated from the beginning if the background interference was too high.

2) Final Sample Volume

Final effluent samples were brought down to final volumes of 10 uL in order to achieve the lowest possible detection level. Invariably surrogate recoveries for final effluents were low in the early sample analyses. When final volumes were made up to 25 uL recoveries noticeably improved for 3 repeated samples (ZE12-0016, ZE13-0005 and ZE13-0024). Therefore, a final volume of 25 uL was selected for use for all samples after week 14 ( ZE14 to ZE31). This volume still permitted the achievement of required project detection limits. A students' t-test (see Appendix 2.2.2 for description) was conducted to compare surrogate recoveries from samples analyzed at a final volume of 10 uL with samples analyzed at a final volume of 25 uL. The t-test (Appendix 2.4, Tables 2.4.1.1 & 2.4.1.2 ) did not indicate that there was a significant ($p \leq 0.1$) improvement of surrogate recovery from both surrogates when final sample volume increased from 10 uL to 25 uL. However, results did clearly demonstrate that there was an average increase of $^{13}C_{12}$-$T_4CDD$ recovery by 9.9% and $^{13}C_{12}$-$O_8CDD$ recovery by 3.5% . Therefore, 25 uL is still recommended as the final volume for final effluent samples. This volume allows repeat injections when it is required.

2.4.2 Instrument Calibration

A Finnigan 4510 GC/MS with Incos data system was used for all PCDD/ F determinations. The instrument was tuned daily using perfluorotributylamine (FC43 ) prior to any analysis. The spectrum of FC43 was checked to ensure mass calibration was accurate. Three point calibration standards ( 50,100 & 250 pg/uL) were carried out whenever the instrument was set up for PCDD/F analysis and one point calibration (100 pg/uL) thereafter. The linearity of the calibration curves was checked when the three point calibrations were performed. Absolute

area counts of the 100 pg/uL calibration standard were plotted over the analysis period (March-September ,1987). Plotted graphs are presented in Fig.2.4.2.1-2.4.2.10 of Appendix 2.4. During most of the analysis period, the responses of each standard fell within the control ranges. The 4 sets of data which were generated towards the end of the analysis period were either outside or close to the upper control limits for each congener. The high area counts were attributed to high instrument sensitivity which resulted from the system clean-up and the column change. The validity of the data was confirmed by the consistent linearity of the calibration curves obtained from each congener at 50,100 and 250 pg/uL and the consistency in the ratio between each congener and the internal standard conducted in the same period.

### 2.4.3 QA/QC

All QA/QC limits employed as the guidelines for the acceptance of the QC results presented in this report were established in the project proposal. The limits set for each QA parameter for the analysis of PCDD/F are briefly described below :

1. Surrogate Recovery

The recovery limits for the two surrogate standards $^{13}C_{12}$-$T_4CDD$ and $^{13}C_{12}$-$O_8CDD$ were 40-120 % for the final effluent samples and 20-120 % for the raw sewage, return recycle and sludge samples. Certain difficulties encountered during sample analysis e.g. variability in same sample matrix, incomplete extraction due to matrix difference, etc. made it impossible to consistently meet the project QA/QC limits, especially for the final effluent samples. Therefore, the following course of action was taken regarding the assessment of surrogate recoveries.

If recoveries were <20% , the samples were re-injected. If the recovery was still unacceptable, the two fractions of the sample extract were combined, subjected to additional clean-up procedures and reanalyzed along with the next batch of samples. If recoveries were still poor, results were reported. Samples in general were not repeated from scratch because by the time the preceeding steps had been completed , hold times for raw samples had been greatly exceeded. However, in a few cases, samples were re-extracted for repeat analysis. Approximately 6.8% of final effluent , 5.3% of raw sewage and 4.7% of sludge samples were repeated from the beginning.

2. Native Spike Recovery

The recovery limits for each standard from water blank spike samples were 50-110%. Samples which had recoveries outside the limits were not repeated.

3.Method Blank

The concentration of any compound in the soxhlet blank was not allowed to exceed 5ng/g whereas, 1 ng/L was the limit for the separatory funnel blank. A very small amount of $T_4CDD$ and $T_4CDF$ was found in one of the separatory funnel blanks. The amount was above the IDL but they were less than 1 ng/L.

4. Replicates

The percentage difference between duplicates was used as an indication of the reproducibility of the analytical technique. Samples were repeated when compounds present in both samples were greater than 5 x MDL and the percentage diffference between duplicates was greater than 50 % (US EPA guideline for organic analyses).

Detailed QC results in each QA parameter are discussed below:

2.4.3.1 Surrogate Recovery

For PCDD/F determination, two C13 analogues were employed as surrogate standards and were added to each sample/blank/spike before sample extractions. The concentrations of these two surrogate standards in the final extracts were 250pg/uL for $^{13}C_{12}$-$T_4$CDD and 500pg/uL for $^{13}C_{12}$-$O_8$CDD. The percentage recovery of each surrogate standard was calculated to track the accuracy of the entire analytical process. The calculation of the recovery is based on the following formula:

$$\%\ \text{SS recovery} = \frac{\text{Sample SS area count}}{\text{Spike SS area count}} \times \frac{\text{Spike IS area count}}{\text{Sample IS area count}} \times 100\%$$

where: SS= Surrogate Standard, $^{13}C_{12}$-$T_4$CDD or $^{13}C_{12}$-$O_8$CDD

IS= Internal Standard, d12-triphenylene

Each surrogate standard recovery from each sample/blank/spike was calculated and tabulated. Detailed results are documented in Appendix 2.4 (Tables 2.4.3.1.1 to 2.4.3.1.7 ) and positive data points (excluding interference) were also plotted and presented in Fig. 2.4.3.1.1 to 2.4.3.1.7 of the same Appendix. Recovery results from different sample matrices, blanks and native spike samples are summarized in Table 2.4.3.1.8. Recoveries outside the project QA/QC limits were highlighted and samples were flagged if they were repeated. All results were screened for outliers by the Box-Whisker method ( see Appendix 2.2 for method description, see Fig. 2.4.3.1.3, 2.4.3.1.6, 2.4.3.1.9, 2.4.3.1.12, 2.4.3.1.15, 2.4.3.1.18 & 2.4.3.1.21 for detailed results). Outliers were flagged and not included in calculating the average recovery and standard deviation.

**ZENON ENVIRONMENTAL INC.**

**PCDD/F- SURROGATE RECOVERY SUMMARY FROM DIFFERENT SAMPLE STREAMS**

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | March-Sept.-1987 |

| Sample Stream Type | 13C12-T4CDD | | | | 13C12-O8CDD | | | |
|---|---|---|---|---|---|---|---|---|
| | Average % Rec. | std. dev. | No of data averaged | No of data rejected | Average % Rec. | std. dev. | No of data averaged | No of data rejected |
| Primary Final Effluent | 60.8 | 18.9 | 8 | 0 | 64.3 | 14.7 | 7 | 1 |
| Secondary Final Effluent | 51.8 | 22.4 | 49 | 3 | 66.9 | 28.3 | 52 | 0 |
| Return Recycle | 59.1 | 14.4 | 8 | 2 | 64.7 | 20.5 | 9 | 1 |
| Raw Sewage | 58.4 | 27.3 | 54 | 3 | 63.6 | 24.8 | 57 | 0 |
| Sludge | 78.3 | 36.8 | 74 | 12 | 72.3 | 27.9 | 85 | 1 |
| Method Blqank | 56.4 | 28.4 | 24 | 0 | 65.6 | 24.3 | 23 | 1 |
| Native Spike | 36.7 | 18.5 | 12 | 0 | 48.6 | 22.2 | 12 | 0 |

Table 2.4.3.1.8

Recovery data were grouped according to the different sample streams: primary final effluent, secondary final effluent, raw sewage, sludge and return recycle (Appendix 2.4, Tables 2.4.3.1.1-2.4.3.1.5). Among the 5 types of sample matrices analyzed, the majority of the recoveries of $^{13}C_{12}$-$T_4CDD$ and $^{13}C_{12}$-$O_8CDD$ from primary final effluent, return recycle and raw sewage were well within the project QA/QC limits. A number of the recoveries from the secondary final effluent group were below the project QA/QC limits (40-110%). ( Appendix 2.4, Fig.2.4.3.1.2) Conversely, a few sludge samples showed recoveries higher than the limits (20-120%). (Appendix 2.4, Fig.2.4.3.1.5) A student t-test was performed on these 5 groups of data to evaluate the recovery efficiency due to the effect of the different sample matrices. Statistical analyses revealed that the recovery efficiency of $^{13}C_{12}$-$T_4CDD$ or $^{13}C_{12}$-$O_8CDD$ was not significantly ($p \leq 0.1$) affected by the 4 types of sample matrices : raw sewage (average recovery - 58.4%, 63.6%), return recycle (average recovery - 59.1%, 64.7%), primary final effluent (average recovery - 60.8%,64.3%) and secondary final effluent ( average recovery - 51.8%,66.9%) investigated. (Appendix 2.4, Tables 2.4.3.1.9 - 2.4.3.1.28) However, a significantly higher recovery ($p<0.01$) of $^{13}C_{12}$-$T_4CDD$ was demonstrated from sludge samples (average recovery - 78.3%) as compared to raw sewage (average recovery - 58.4%) and secondary final effluent samples (average recovery -51.8%). (Appendix 2.4, Tables 2.4.3.1.23 & 2.4.3.1.27) Furthermore, $^{13}C_{12}$-$O_8CDD$ recoveries from sludge samples ( average recovery - 72.3%) were also significantly ($p<0.1$) higher than raw sewage samples (average recovery - 63.6%). (Appendix 2.4, Table 2.4.3.1.17) This indicates that $^{13}C_{12}$-$T_4CDD$ and $^{13}C_{12}$-$O_8CDD$ were either more readily recovered from sludge samples containing more solids than final effluent and raw sewage samples or it may have been that sludge samples caused more background interference than the other type of matrices.

The recoveries for $^{13}C_{12}$-$T_4CDD$ and $^{13}C_{12}$-$O_8CDD$ from the separatory funnel and soxhlet blanks are tabulated in Table 2.4.3. 1.6 . and also graphically shown in Fig. 2.4.3.1.6. of the Appendix 2.4 . The average recovery for $^{13}C_{12}$-$T_4CDD$ was 56.4% and for $^{13}C_{12}$-$O_8CDD$ was 65.6%. These recovery figures were comparable to the recoveries obtained from real samples.

Surrogate standard recoveries from native spike samples which were carried out by spiking a known amount of standard mixture containing all PCDD/F congeners into a reagent water blank sample are presented in Table 2.4.3. 1.7 . The average recovery was 36.7% for $^{13}C_{12}$-$T_4CDD$ and 48.6% for $^{13}C_{12}$-$O_8CDD$. These values were lower than surrogate standard recoveries obtained from true samples. This may be the result of an incomplete extraction of these samples or more likely due to higher losses from evaporation caused by a less complex sample matrix. Similar behavior has been observed in many projects.

2.4.3.2 Native Spike Recovery

A known amount of standard mixture containing all PCDD/F congeners was spiked into a reagent water blank sample. The final water concentration of each congener spiked was 1000 ng/L. The percentage recovery of individual congener in the mixture was calculated using the following formula:

$$\text{\% Recovery of congener A} = \left(\frac{\text{Spike A area count}}{\text{Std. A area count}} \times \text{Std.A conc.} \times \text{Spike A final vol.} \times \frac{\text{Std.IS area count}}{\text{Spike IS area count}}\right) / \text{Spike A amt. added} \times 100\%$$

IS=internal standard, d12-triphenylene

The recovery results from 12 of these spiked samples are individually presented in Appendix 2.4 (Tables 2.4.3.2.1-2.4.3.2.12 ) and summarized in Table 2.4.3.2.13. All data are also graphically presented in Fig.2.4.3.2.1 & 2.4.3.2.2 of Appendix 2.4. Recoveries outside the project QA/QC limits are highlighted and all data were also checked for outliers by the Box-Whisker method. (see Appendix 2.2.1 for method description, seeAppendix 2.3 Fig. 2.4.3.2.3 - 2.4.3.3.6 for detailed results) Compounds which had recoveries outside the QA/QC limits were not repeated. Most compounds from the March 31st sample showed recoveries lower than the project acceptable limits. Conversely, most recoveries from the Sept. 2 sample were higher than the QA/QC limits. This seems to be the result of the accuracy with which the volume of the spike solution was measured. The recovery of $H_6CDD$ (290%) from the March 20 sample and $T_4CDD$ (149%) from the Sept. 2 sample were not included in the calculation of the average recoveries because they were outliers, according to the method of Box-Whisker. (see Appendix 2.2 for method description , see Fig.2.4.3.2.5 for detailed results) The average recovery for each compound from the 12 samples analyzed was between 54% ($T_4CDF$) and 101% ($H_7CDF$) which are within the project recovery limit (50-110%). (Appendix 2.4, Table 2.4.3.2.13)

2.4.3.3 Method Blank

A method blank was extracted along with each batch of samples to identify possible contamination contributed by glassware, reagents, other samples etc. If concentration of any compound in the soxhlet blank was greater than 5ng/g and separatory funnel blank exceeded 1 ng/L, the samples performed in the same analytical run as the method blank were repeated. A separatory funnel blank was conducted along with a batch of liquid samples while a soxhlet blank was carried out along with a group of sludge samples.

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst OC/MM

Instrument MS/GC Analysis Date Mar.-Sept.1987

| PARAMETER | Mar.10 % | Mar.20 % | Mar.31 % | Apr.7 % | Apr.24 % | May 02 % | May 17 % | May 25 % | Jun 02 % | Jul 21 % | Aug 06 % | Sep 02 % | Average Recovery | Std. Dev. | No of data averaged | No of data rejected |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ΣTetra-CDF | 10 | 18 | 30 | 45 | 78 | 79 | 68 | 35 | 59 | 63 | 56 | 128 | 54 | 31.4 | 12 | 0 |
| ΣTetra-CDD | 59 | 105 | 67 | 39 | 88 | 88 | 65 | 60 | 72 | 62 | 22 | 149 # | 66 | 21.9 | 11 | 1 |
| ΣPenta-CDF | 74 | 79 | 36 | 70 | 101 | 100 | 66 | 64 | 81 | 53 | 50 | 117 | 71 | 24.7 | 12 | 0 |
| ΣPenta-CDD | 48 | 80 | 34 | 69 | 44 | 93 | 65 | 50 | 85 | 64 | 43 | 95 | 62 | 21.5 | 12 | 0 |
| ΣHexa-CDF | 98 | 130 | 39 | 72 | 99 | 100 | 62 | 52 | 108 | 73 | 64 | 108 | 80 | 28.9 | 12 | 0 |
| ΣHexa-CDD | 82 | 290 # | 41 | 80 | 102 | 110 | 59 | 42 | 58 | 55 | 45 | 108 | 69 | 26.7 | 11 | 1 |
| ΣHepta-CDF | 97 | 150 | 50 | 97 | 171 | 88 | 127 | 101 | 139 | 56 | 63 | 125 | 101 | 39.7 | 12 | 0 |
| ΣHepta-CDD | 71 | 68 | 47 | 94 | 115 | 110 | 105 | 65 | 83 | 61 | 46 | 118 | 79 | 26.7 | 12 | 0 |
| Octa-CDF | 86 | 130 | 51 | 60 | 91 | 88 | 33 | 79 | 109 | 83 | 61 | 94 | 78 | 26.4 | 12 | 0 |
| Octa-CDD | 69 | 77 | 40 | 76 | 146 | 84 | 37 | 71 | 106 | 131 | 65 | 137 | 83 | 36.8 | 12 | 0 |

# outlier, not included in the calculation

Table 2.4.3.2.13

All method blank samples were treated as true samples. One litre of water was used in the separatory funnel blank extraction whereas an aliquot of sodium sulfate was used for the soxhlet blank. Twelve separatory funnel and twelve soxhlet blanks were analyzed in this project.

2.4.3.4 Replicates

Nineteen pairs of samples (1-SL, 12-FE, 6-RS) were analyzed as laboratory duplicates: i.e.two aliquots were taken from a single sample and carried through the entire analytical process. Duplicate analyses provide a measure of analysis variability. The percentage difference between duplicates was calculated if concentrations in both duplicates were greater than 5 x MDL (US EPA guideline for inorgainc analyses). The formula for calculating the percentage of difference between duplicates is:

$$\text{Percentage difference} = \frac{\text{conc. in analysis 1 - conc. in analysis 2}}{(\text{conc. in analysis 1+conc. in analysis 2})/2} \times 100\%$$

Samples required reanalyses if the difference between duplicates was greater than 50%. Among the 19 pairs of duplicates analyzed for MISA STP-40 program , only 11 ( out of 380 data points) positive results were observed and they were less than 5 x MDL. Therefore, no percentage difference was calculated and results were not subjected to quality assuarance assessment. Detailed information was tabulated and presented in Table 2.4.3.4.1.

**ZENON ENVIRONMENTAL INC.**

**PCDD/F-REPLICATE SUMMARY**

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | Mar-Sept/87 |

| PARAMETER | ZE06-0005 Conc. ng/L | ZE07-0030 Conc. ng/L | ZE09-0010 Conc. ng/L | ZE14-0019 Conc. ng/L | ZE15-0017 Conc. ng/L | ZX18-0027 Conc. ng/L | ZX20-0008 Conc. ng/L | ZX21-0012 Conc. ng/L | ZX22-0025 Conc. ng/L | ZX23-0021 Conc. ng/L |
|---|---|---|---|---|---|---|---|---|---|---|
| ΣTetra-CDF | ND | ND | ND | ND | 0.91 * | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | 0.88 * | ND | ND | ND | ND | ND |
| ΣTetra-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣPenta-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣPenta-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHexa-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHexa-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHepta-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHepta-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Octa-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Octa-CDD | 0.83 * | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | 1 * | ND | ND | ND | ND | ND | ND | ND | ND | ND |

ND-not detected
* concentration was <5MDL, no comparison was made between duplicates

Table 2.4.3.4.1

ZENON ENVIRONMENTAL INC.

PCDD/F-REPLICATE SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | Mar-Sept/87 |

| PARAMETER | ZX23-0028 Conc. ng/L | ZEX25-0006 Conc. ng/g | ZX25-0008 Conc. ng/L | ZX26-0008 Conc. ng/L | ZX27-0001 Conc. ng/L | ZX28-0021 Conc. ng/L | ZE29-0006 Conc. ng/L | ZE29-0022 Conc. ng/L | ZX31-0014 Conc. ng/L |
|---|---|---|---|---|---|---|---|---|---|
| | ND | ND | ND | ND | 0.54 * | ND | ND | ND | ND |
| ΣTetra-CDF | ND | ND | ND | ND | 0.41 * | ND | ND | ND | ND |
| | ND | ND | ND | ND | 0.18 * | ND | ND | ND | ND |
| ΣTetra-CDD | ND | ND | ND | ND | 0.2 * | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣPenta-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣPenta-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHexa-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | 0.64 * | ND | ND | ND | ND |
| ΣHexa-CDD | ND | ND | ND | ND | 0.7 * | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHepta-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ΣHepta-CDD | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Octa-CDF | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | ND | 0.53 * | ND | ND | ND | ND | ND | ND | ND |
| Octa-CDD | ND | 0.073 * | ND | ND | ND | ND | ND | ND | ND |

ND-not detected
* concentration was <5MDL, no comparison was made between duplicates

Table 2.4.3.4.1

## 2.5 Total Phenols

Total phenols were also analyzed in some of the samples submitted for this project. The contract required detection limits (MDL) for total phenols were:

0.1 ppm (mg/L) for final effluent samples

0.5 ppm (mg/L) for raw sewage /return recycle samples

1.0 ppm (mg/kg) for sludge cake samples.

In order to provide maximum useable data , all values to the limit of instrument sensitivity were reported, i.e. any sample absorbance which exceeded the blank by 0.001 or more absorbance units.

The total phenols standard was purchased from BDH and the purity of the standard was > 99%, which was independently verified throughout the course of the project by bromine/thiosulphate titration.

### 2.5.1 Analytical Method

Total phenols were analyzed by a direct photometric method (ASTM standard method D 1783). This method is based on the reaction of steam-distillable phenolic compounds with 4-aminoantipyrine at a pH of 10±0.2 in the presence of potassium ferricyanide. The antipyrine colour found in aqueous solution was measured at 510 nm.

Raw sewage and return recycle samples were diluted by 1:5 with in-house produced reversed-osmosis deionized (RO/DI) water before analysis.

Final effluent samples were analyzed directly without any dilution.

Sludge samples were diluted by 1:10 with (RO/DI) water before analysis.

Sludge cake samples were handled as below:

10 g of sample were added to 100 mL RO/DI water and followed by 5 mL concentrated phosphoric acid and 1 g copper sulfate. Samples were allowed to react at room temperature for 1 hour before proceeding with the analysis.

Observations/Problems

No problems were encountered in most of the analyses. Samples submitted from Sudbury in May were noticed to have a yellow colour instead of the normal blue colour. In addition, no preservatives eg. copper sulfate were found at the bottom of the sample bottles. These findings were reported to the Ministry . Therefore, the data generated from Sudbury in May should be assessed with the above information in mind.

2.5.2 QA/QC

There was no clear establishment of the QA/QC limits for total phenols analysis in the project proposal. Therefore, the in-house QA/QC limits were used and will be briefly described as following:

1. Matrix spike recovery

An aliquot of one in every 20 samples analyzed was spiked with a known amount of total phenols (TP) standard. This procedure provides assurance that the method used was free of interference for the type of matrix analyzed. The concentration of the total phenols standard used for spiking was at least 10 times greater than the method detection limit for that particular sample matrix.

The QA/QC recovery limit of 75-125% was set for this analysis in-house. The sample was repeated if the recovery was outside the limits.

2. Method Blank

Concentration of the total phenols in the method blank was not allowed to exceed the MDL set for final effluent samples (0.5 ppm). Otherwise, samples performed in the same analytical run as the method blank were repeated.

3. Replicates

The percentage difference between duplicates was calculated if compounds present in both samples were greater than 5 x MDL ( US EPA guideline) to evaluate the accuracy of the analytical technique. The percentage difference between duplicates was flagged and repeated if it was greater than 50% (US EPA guideline for organic analyses).

Detailed results in each QA parameter for total phenols analysis are presented below:

### 2.5.2.1 Matrix Spike Recovery

One mg/L phenol was spiked into each sample to measure its recovery. The percentages of the matrix spike recovery from 33 samples are tabulated in Table 2.5.3.1.1 and plotted in Appendix 2.5 (Fig. 2.5.3.1.1). The results were checked for outliers by the Box-Whisker method (see Appendix 2.2.1 for method description, see Fig. 2.5.3.1.2 for detailed results).

The percentage of the matrix spike recovery was calculated using the following formula:

$$\%\ \text{matrix spike recovery} = \frac{\text{TP conc.in spike sample - TP conc. in sample}}{\text{TP conc. in spike std.}} \times 100\%$$

The recovery of total phenols from different types of matrices was between 85% to 121% with a mean of 101.7% (Table 2.5.3.1.1). No recovery was outside the QA/QC limit (75-125%). A students' t-test ( see Appendix 2.2.2 for definition, see Tables 2.5.3.1.2 to 2.5.3.1.7 for detailed results) was performed on the recovery data to evaluate the sample matrix effect on spike recovery. Statistical tests indicated that there was a significantly higher ($p<0.05$) recovery of total phenols from raw sewage and secondary final effluent samples than from return recycle samples.

ZENON ENVIRONMENT INC.

TOTAL PHENOL-MATRIX SPIKE RECOVERY SUMMARY

| Sample ID | Amount Added (mg/L) | Sample Conc. (mg/L) | Amount Found (mg/L) | Sample Matrix Type | Recovery |
|---|---|---|---|---|---|
| ZE04-0231 | 1 | 0.07 | 1.1 | 2°-FE | 103 |
| ZE04-0232 | 1 | 0.28 | 1.2 | RS | 92 |
| ZE05-0004 | 1 | 0 | 0.93 | 2°-FE | 93 |
| ZE05-0009 | 1 | 0 | 0.93 | RS | 93 |
| ZE05-0017 | 1 | 0.72 | 1.68 | SL | 96 |
| ZE07-0018 | 1 | 0 | 1.07 | 2°-FE | 107 |
| ZE07-0074 | 1 | 0.08 | 1.08 | RS | 100 |
| ZE09-0012 | 1 | 0.13 | 1.03 | RR | 90 |
| ZE09-0032 | 1 | 0.14 | 1.05 | SL | 91 |
| ZE10-0008 | 1 | 1.17 | 2.27 | SC | 110 |
| ZE10-0028 | 1 | 0.07 | 1.13 | RS | 106 |
| ZE11-0019 | 1 | 0.07 | 1.19 | RS | 112 |
| ZE12-0019 | 1 | 0 | 1.02 | RS | 102 |
| ZE12-0035 | 1 | 0 | 1.09 | RS | 109 |
| ZE14-0012 | 1 | 0 | 1.09 | RS | 109 |
| ZE17-0012 | 1 | 0 | 1.01 | 2°-FE | 101 |
| ZE18-0009 | 1 | 0 | 0.93 | RS | 93 |
| ZE19-0014 | 1 | 0 | 0.99 | RS | 99 |
| ZE20-0014 | 1 | 0 | 1.18 | 2°-FE | 118 |
| ZE21-0013 | 1 | 0.14 | 1.08 | RS | 94 |
| ZE21-0014 | 1 | 0 | 1.13 | 2°-FE | 113 |
| ZE21-0024 | 1 | 0.05 | 1.18 | 2°-FE | 113 |
| ZE21-0033 | 1 | 0.05 | 0.9 | RR | 85 |
| ZE22-0002 | 1 | 0 | 1.18 | 2°-FE | 118 |
| ZE22-0012 | 1 | 0 | 1.08 | RS | 108 |
| ZE24-0007 | 1 | 0.5 | 1.33 | SL | 83 |
| ZE25-0001 | 1 | 0 | 0.94 | RS | 94 |
| ZE25-0005 | 1 | 1.38 | 2.5 | SL | 112 |
| ZE27-0005 | 1 | 0.3 | 1.29 | 2°-FE | 99 |
| ZE28-0017 | 1 | 0 | 1.04 | 2°-FE | 104 |
| ZE28-0030 | 1 | 0 | 1.21 | 2°-FE | 121 |
| ZE30-0024 | 1 | 0 | 0.85 | 2°-FE | 85 |
| ZE31-0032 | 1 | 1.83 | 0.8 | SL | 103 |
| Average | | | | | 101.7 |

2°-FE- secondary final effluent
SL- sludge
RS- raw sewage
RR- return recycle
SC- sludge cake

Table 2.5.3.1.1

2.5.2.2 Method Blank

A method blank was analyzed along with each analytical run. Analysis of method blanks could identify possible contamination contributed by glassware, reagent, instrument etc. Results of 43 method blanks are tabulated in Table 2.5.3.2.1. The total phenols content in all blank samples was below the detection limit. (0.5 mg/L) set for final effluent samples.

2.5.2.3 Replicates

Forty-six duplicate samples were analyzed for total phenol content. Forty pairs of samples were found to have total phenol content below its respective detection limit . The percentage difference between duplicates was calculated if concentrations in both duplicates were greater than 5 x MDL ( US guidelline) and the calculated results are presented in Table 2.5.3.3.1. The formula for calculating the percentage difference between duplicates is:

$$\% \text{ difference} = \frac{\text{Conc. in analysis 1 - Conc. in analysis 2}}{(\text{Conc. in analysis 1 + conc. in analysis 2})/2} \times 100\%$$

The average percentage difference was 13.5% for 6 pairs of sludge samples which showed total phenol content above 5 x MDL (Table 2.5.3.3.1). None of the percentage difference was outside the QA/QC limit (50%). Information regarding analytical precision by duplicate analysis from matrices other than sludge samples could not be provided by the current project.

ZENON ENVIRONMENTAL INC.

TOTAL PHENOLS-METHOD BLANK SUMMARY

| Analysis Date | Concentration (mg/L) |
|---|---|
| Jan.27,1987 | <0.05 |
| Jan.28,1987 | <0.05 |
| Jan.28,1987 | <0.05 |
| Jan.29,1987 | <0.05 |
| Jan.30,1987 | <0.05 |
| Feb.2,1987 | <0.05 |
| Feb.3,1987 | <0.05 |
| Feb.23,1987 | <0.05 |
| Feb.24,1987 | <0.05 |
| Feb.24,1987 | <0.05 |
| Feb.25,1987 | <0.05 |
| Feb.26,1987 | <0.05 |
| Feb.26,1987 | <0.05 |
| Mar.2,1987 | <0.05 |
| Mar.4,1987 | <0.05 |
| Mar.10,1987 | <0.05 |
| Mar.17,1987 | <0.05 |
| Mar.18,1987 | <0.05 |
| Mar.20,1987 | <0.05 |
| Mar.20,1987 | <0.05 |
| Mar.28,1987 | <0.05 |
| Mar.28,1987 | <0.05 |
| Apr.9,1987 | <0.05 |
| Apr.13,1987 | <0.05 |
| Apr.14,1987 | <0.05 |
| Apr.20,1987 | <0.05 |
| May 25,1987 | <0.05 |
| June 2,1987 | <0.05 |
| June 3,1987 | <0.05 |
| June 4,1987 | <0.05 |
| June 8,1987 | <0.05 |
| June 9,1987 | <0.05 |
| June 11,1987 | <0.05 |
| June 18,1987 | <0.05 |
| June 22,1987 | <0.05 |
| June 22,1987 | <0.05 |
| July 8,1987 | <0.05 |
| Aug. 5,1987 | <0.05 |
| Aug. 10,1987 | <0.05 |
| Aug. 12,1987 | <0.05 |
| Aug. 18,1987 | <0.05 |
| Aug. 19,1987 | <0.05 |
| Aug. 28,1987 | <0.05 |

Table 2.5.3.2.1

ZENON ENVIRONMENTAL INC.

TOTAL PHENOLS-REPLICATES SUMMARY

| Sample I.D. | first analysis | second analysis | Sample Matrix Type | % Diff * |
|---|---|---|---|---|
| ZE-04-0004 | < 0.5 (mg/l) | < 0.5 (mg/l) | 2°-FE | |
| ZE-05-0008 | < 0.5 (mg/l) | < 0.5 (mg/l) | 2°-FE | |
| ZE-05-0017 | 6.6 (mg/kg) | 8.1 (mg/kg) | SL | 20.4% |
| ZE-06-0001 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-07-0008 | < 0.1 (mg/l) | < 0.1 (mg/l) | 1°-FE | |
| ZE-07-0050 | 11 (mg/kg) | 9.5(mg/kg) | SL | 14.6% |
| ZE-07-0074 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-09-0012 | < 0.5 (mg/l) | < 0.5 (mg/l) | RR | |
| ZE-09-0032 | < 1 (mg/kg) | < 1 (mg/kg) | SL | |
| ZE-10-0008 | 12 (mg/kg) | 11.4 (mg/kg) | SL | 5.1% |
| ZE-10-0028 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-11-0019 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-12-0008 | 6.5(mg/kg) | 6(mg/kg) | SL | 8.0% |
| ZE-12-0019 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-12-0034 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-13-0026 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-13-0036 | < 0.5 (mg/l) | < 0.5 (mg/l) | RS | |
| ZE-13-0037 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-13-0038 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-13-0039 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-14-0034 | <0.5(mg/l) | <0.5(mg/l) | RS | |
| ZE-15-0014 | 9.1mg(/kg) | 12(mg/kg) | SL | 27.5% |
| ZE-17-0011 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-17-0018 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-18-0003 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-19-0017 | <0.1 (mg/l) | <0.1 (mg/l) | 1°-FE | |
| ZE-20-0001 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-20-0012 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-20-0031 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-21-0013 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-21-0028 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-22-0015 | 5.5(mg/kg) | 5.2(mg/kg) | SL | 5.6 % |
| ZE-23-0001 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-23-0008 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-24-0006 | 1.4(mg/kg) | 1.7(mg/kg) | SL | |
| ZE-24-0007 | 1.5(mg/kg) | 1.3(mg/kg) | SL | |
| ZE-25-0009 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-27-0007 | 1.3(mg/kg) | 1.3(mg/kg) | RS | |
| ZE-27-0017 | 1 (mg/kg) | 0.8(mg/kg) | SL | |
| ZE-28-0002 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-28-0014 | <0.1 (mg/l) | 0.12 (mg/l) | 2°-FE | |
| ZE-28-0039 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| ZE-29-0019 | <0.1 (mg/l) | <0.1 (mg/l) | 2°-FE | |
| ZE-30-0018 | 2.3(mg/kg) | 2.8(mg/kg) | RR | |
| ZE-31-0006 | <0.1 (mg/l) | <0.1 (mg/l) | 1°-FE | |
| ZE-31-0041 | <0.5 (mg/l) | <0.5 (mg/l) | RS | |
| Average | | | | 13.5% |

* % difference was calculated only if both sample concentrations were >5XMDL
1°-FE- primary final effluent
2°-FE- secondary final effluent
RS- raw sewage
Sl- sludge
RR- return recycle

Table 2.5.3.3.1

# Joint MOE/Environment Canada/MEA
# Municipal Sewage Treatment Plants
# Pilot Monitoring Project
# Volume 2 - Appendices

**Submitted to:**

**Ontario Ministry of the Environment**

**Prepared by:**


**ZENON ENVIRONMENTAL INC.**
**845 Harrington Court**
**Burlington, Ontario**



**January 1988**

**File: AN873095**
**Disk: MISA-MOE Report, A.K.Y.**

# APPENDIX 2.1

As provided by Mann Testing

# APPENDIX 2.2

## Appendix 2.2.1

## BOX-WHISKER METHOD

This method is used to determine outliers from a set of data.

The left and right sides of the box are approximately at the 25th percentile and 75th percentile of the number of points in the data arranged in descending or ascending order.

The left and right whiskers extend to values which represent 1.5 times the width oif the box. Any data points falling outside these values are plotted as individual points and referred as outliers.

## Appendix 2.2.2

## STUDENTS' t-TEST

The students' t-test used in the current project was to compare the means of two independently collected (unpaired) samples.

A significance level less than 0.1 ( 90% probability) was sufficient to reject the hypothesis that the two samples came from populations with the same mean.

A significance level greater than 0.1 ( 90% probability) was sufficient to accept the hypothesis that the two samples came from populations with the same mean.

## APPENDIX 2.2.3
## DETAILED ANALYTICAL METHOD FOR VOLATILES

### 2.2.3.1 Nutech 8522 System

A Nutech 8522 sample concentrator system was used for the analysis of all the samples and standards analyzed on the Finnigan 4510. 100 ng each of $d_8$ toluene, $d_5$-chlorobenzene, $d_4$-dichloroethane and bromofluorobenzene were added as surrogate standards to all samples prior to analysis.

Standards were injected into 5.0 mL blank water and processed as a normal sample.

In addition, a system blank was analysed to establish any extraneous contribution of volatile organics.

The sample was loaded into the purge vessel and processed using the following instrumental conditions:

| | |
|---|---|
| Sparge: | Helium 30 mL/min for 10 min. |
| Temperatures: Valve | 185°C |
| Line | 185°C |
| Trap (Cool) | 25°C |
| Trap (Heat) | 210°C |
| Port 1 | 200°C |
| Port 2 | 200°C |
| Bake Oven | 180°C |
| G.C. Carrier Flow | 3mL/min. |

The gas chromatographic conditions used on the Finnigan 4510 are listed below:

| | |
|---|---|
| Column: | 30 M DB5 0.3 mm ID |
| Temp. Prog: | -45°C for 2 min. |
| | -45°C to 120°C at 10° |
| | 120°C to 200°C at 20°C/min |
| Injector: | On-column |

The mass spectrometer conditions used in the analyses are listed below:

Electron Impact mode, scanning 45-300 AMU each second

| | |
|---|---|
| Electron energy | 70 eV |
| Em voltage | 1300 eV |
| Emission Current | 0.5 A |

The U.S. EPA standard mixture prepared by Radian Corporation was used for quantifications of all volatile organics listed in EPA Method 624. The GC/MS was calibrated with PFTBA (FC-43).

Quantification was performed using the external standard method, as detailed in the Federal Register, on peak areas from reconstructed ion plots for the quantifications ions listed in the EPA Federal Register. Assurance of correct identification was performed using the secondary ions and in the case of higher level determinations, using the full scan spectra.

2.2.3.2 Envirochem 810 System

An Envirochem Series 810 volatile analyser was used for the analysis of all the samples and standards analysed on the HP-MSD. 50 ng each of $d_8$-toluene, $d_5$-chlorobenzene, bromofluorobenzene and $d_4$-dichloroethane were added as surrogate standards to all samples prior to analysis.

Standards were injected into 5.0 mL blank water and processed as a normal sample.

In addition, a system blank was analysed to establish any extraneous contribution of volatile organics.

The sample was loaded into the purge vessel and processed using the following instrumental conditions:

| | |
|---|---|
| Sparge: | Helium 30 mL/min for 10 min. |
| Temperatures: | |
| Trap #1 (Wide Bore) | |
| -Cool | 50°C |
| -Heat | 250°C |
| Trap *#2 (Narrow Bore) | |
| -cool | 50°C |
| -heat | 250°C |
| Transfer Line | -250°C |
| G.C. Carrier Flow | 2mL/min. |

The gas chromatographic conditions for the HP-MSD are listed below:

| | |
|---|---|
| Column: | 30 M DB5 0.25 mm ID |
| Temp. Prog: | -40°C for 2 min. |
| | -40°C to 120°C at 10°C/min. |
| | 120°C to 200°C at 20°C/min. |
| Injector: | Direct |
| Injection Temp: | 150°C |

The mass spectrometer conditions used in the analyses are listed below:

| | |
|---|---|
| Electron Impact mode, scanning 45-300 AMU each second | |
| Electron energy | 70 eV |
| Em voltage | 1300 eV |
| Emission Current | 0.5 A |

The U.S. EPA standard mixture prepared by Radian Corporation was used for quantifications of all volatile organics listed in EPA Method 624. The GC/MS was calibrated with PFTBA (FC-43).

Quantification was performed using the external standard method, as detailed in the Federal Register, on peak areas from reconstructed ion plots for the quantifications ions listed in the EPA Federal Register. Assurance of correct identification was performed using the secondary ions and in the case of higher level determinations, using the full scan spectra.

Fig. 2.2.2.1 to Fig.2.2.2.10

UCL - Upper Control Limit (mean +3SD)

UWL - Upper Warning Limit (mean + 2SD)

LCL - Lower Control Limit (levels were set according to historical data)

# VOA-INSTRUMENT RESPONSE CHART
## (Chloroform-10ppb)

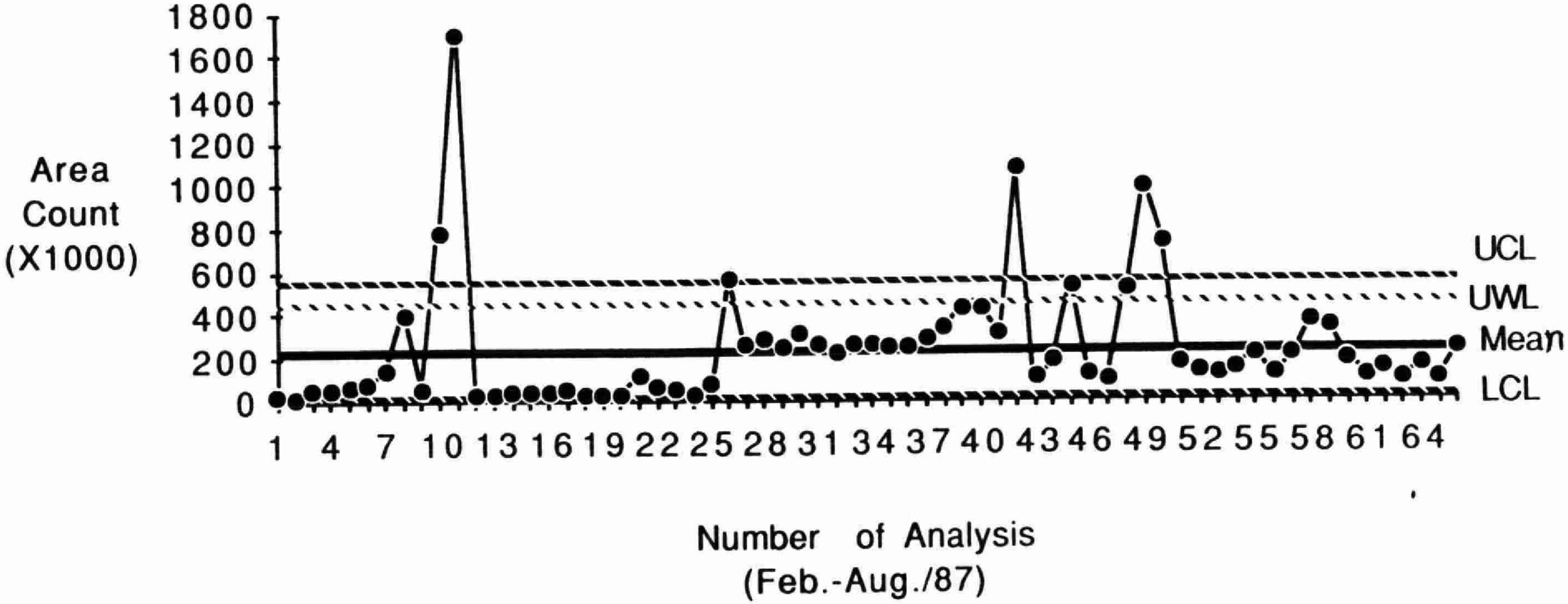


Fig. 2.2.2.1

## VOA-INSTRUMENT RESPONSE CHART
## (1,1,1-Trichloroethane-10ppb)

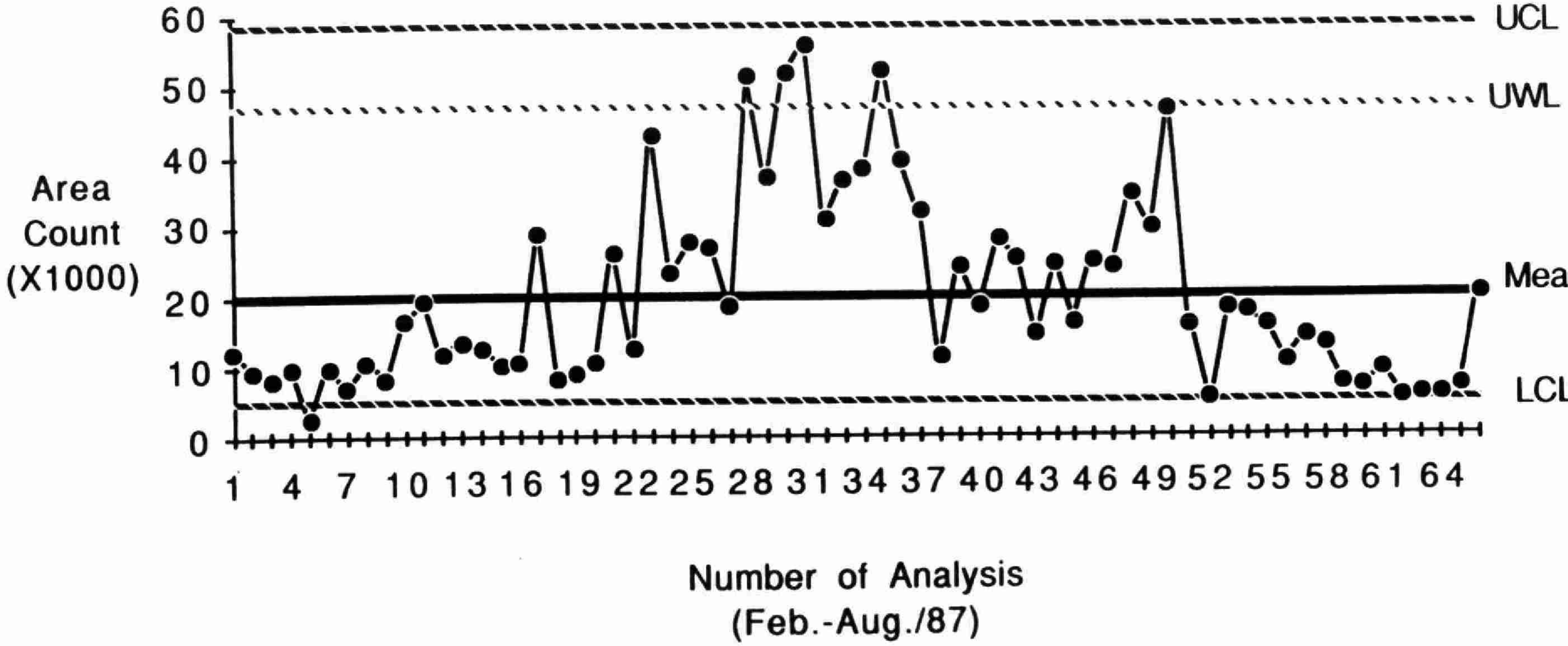


Fig. 2.2.2.2

# VOA-INSTRUMENT RESPONSE CHART
## (Methylene chloride-10ppb)

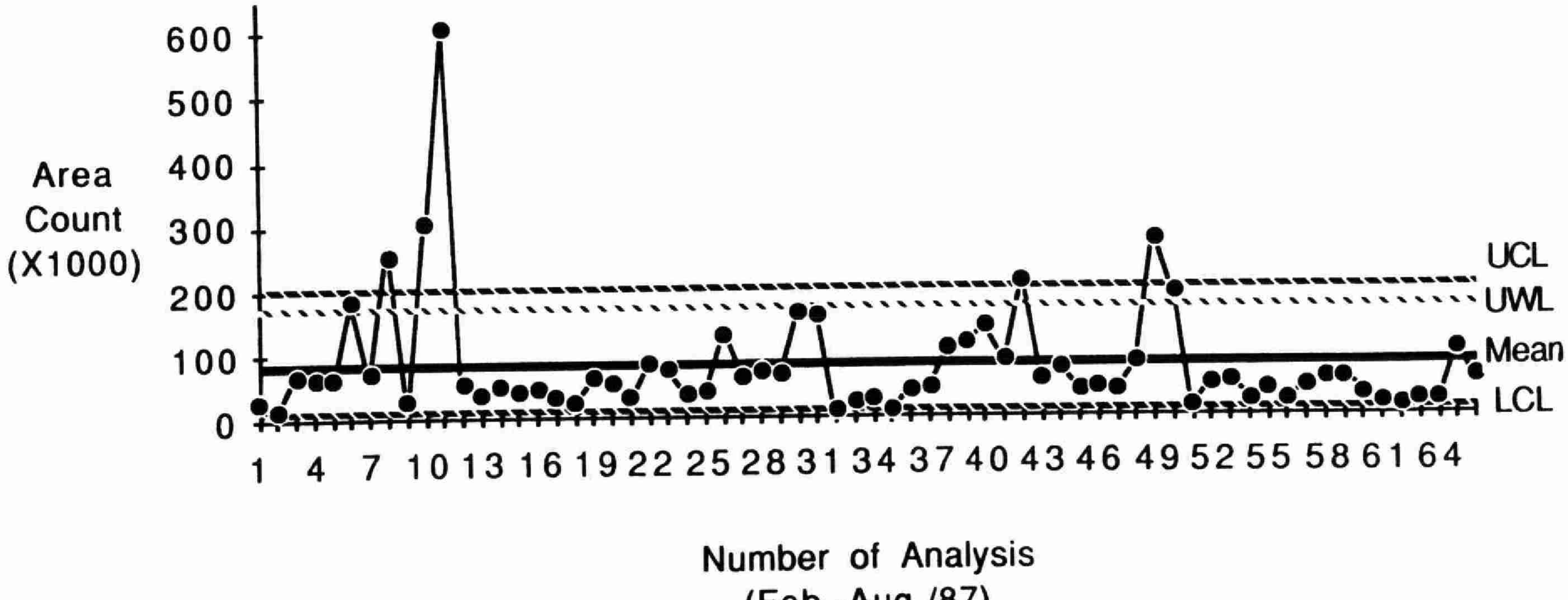


Fig. 2.2.2.3

**VOA-INSTRUMENT RESPONSE CHART**
**(Hexane-10ppb)**

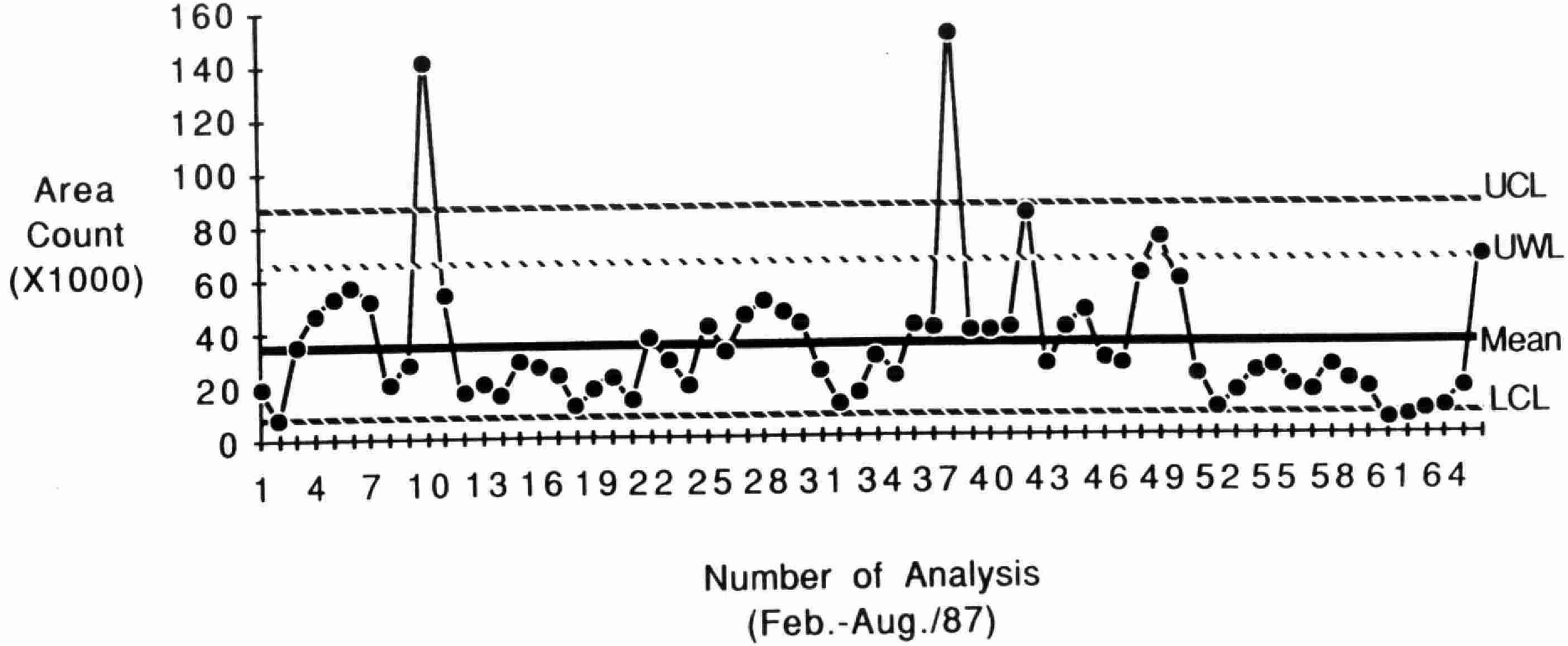


Fig. 2.2.2.4

## VOA-INSTRUMENT RESPONSE CHART
## (Benzene-10ppb)

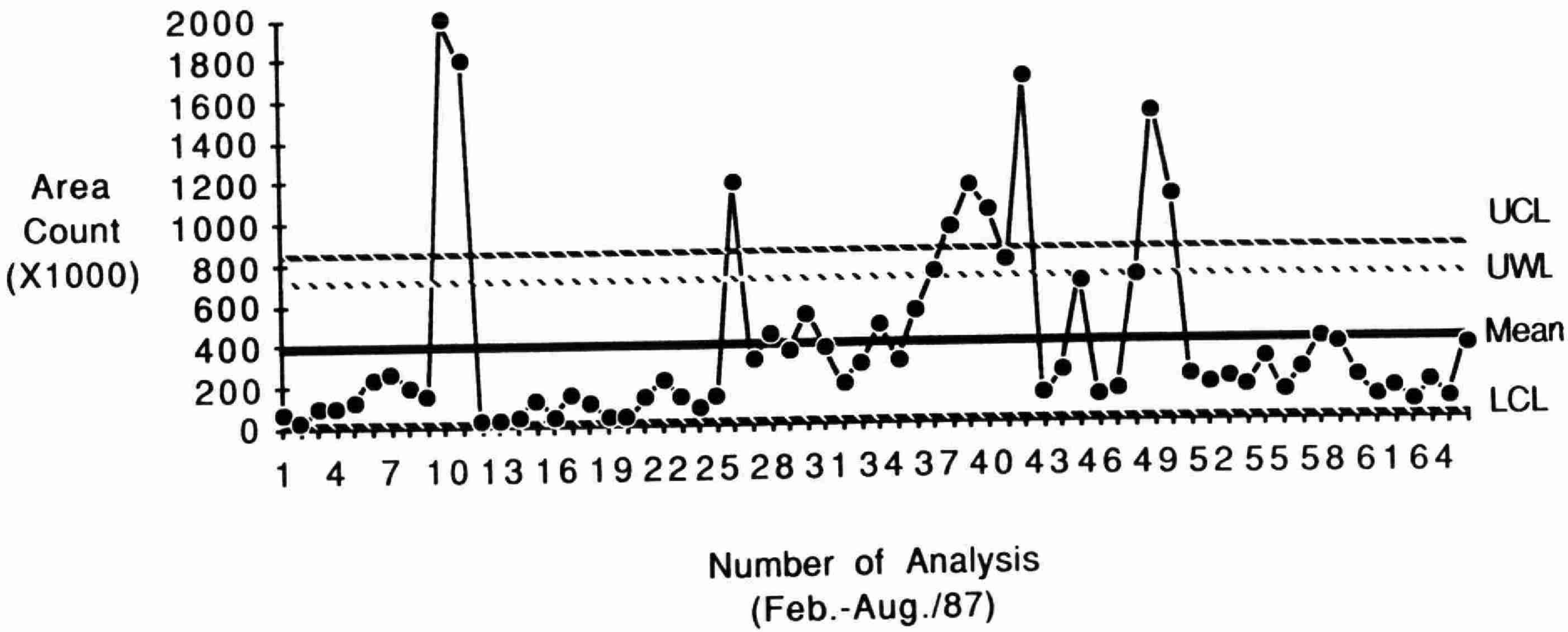


Fig. 2.2.2.5

## VOA-INSTRUMENT RESPONSE CHART
### (Ethylbenzene-10ppb)

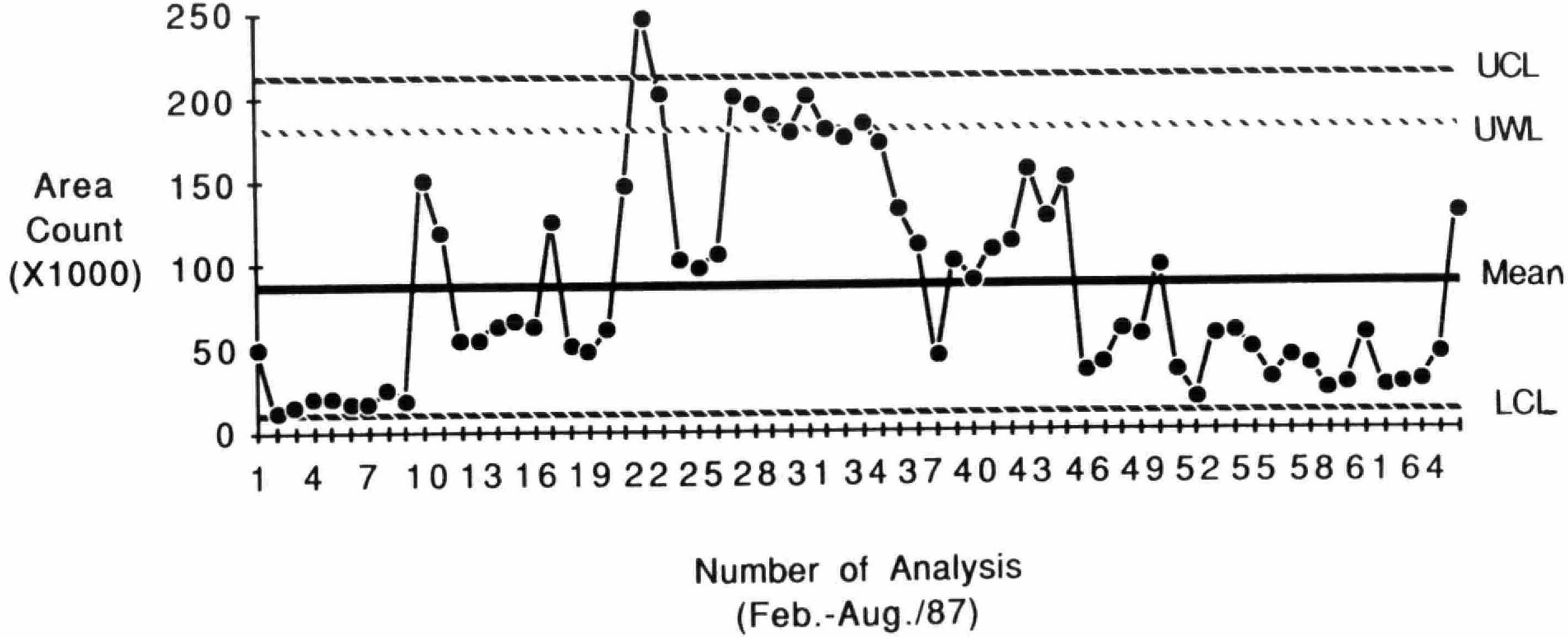


Fig. 2.2.2.6

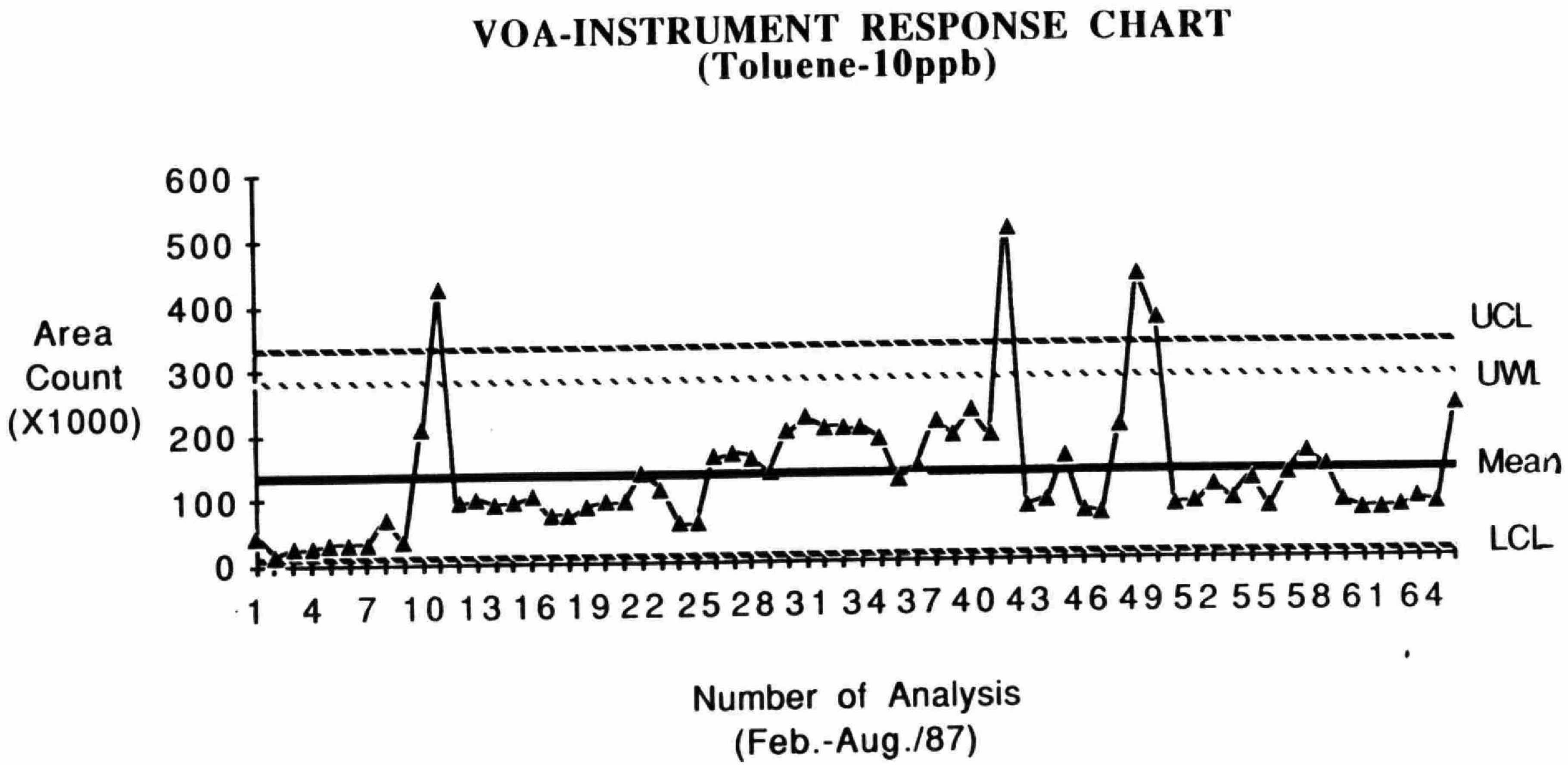
VOA-INSTRUMENT RESPONSE CHART
(Toluene-10ppb)
Area
Count
(X1000)
600
500
400
300
200
100
0
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
UCL
UWL
Mean
LCL
Number of Analysis
(Feb.-Aug./87)

Fig. 2.2.2.7

**VOA-INSTRUMENT RESPONSE CHART**
**(1,3 &1,4-Dimethylbenzene-10ppb)**

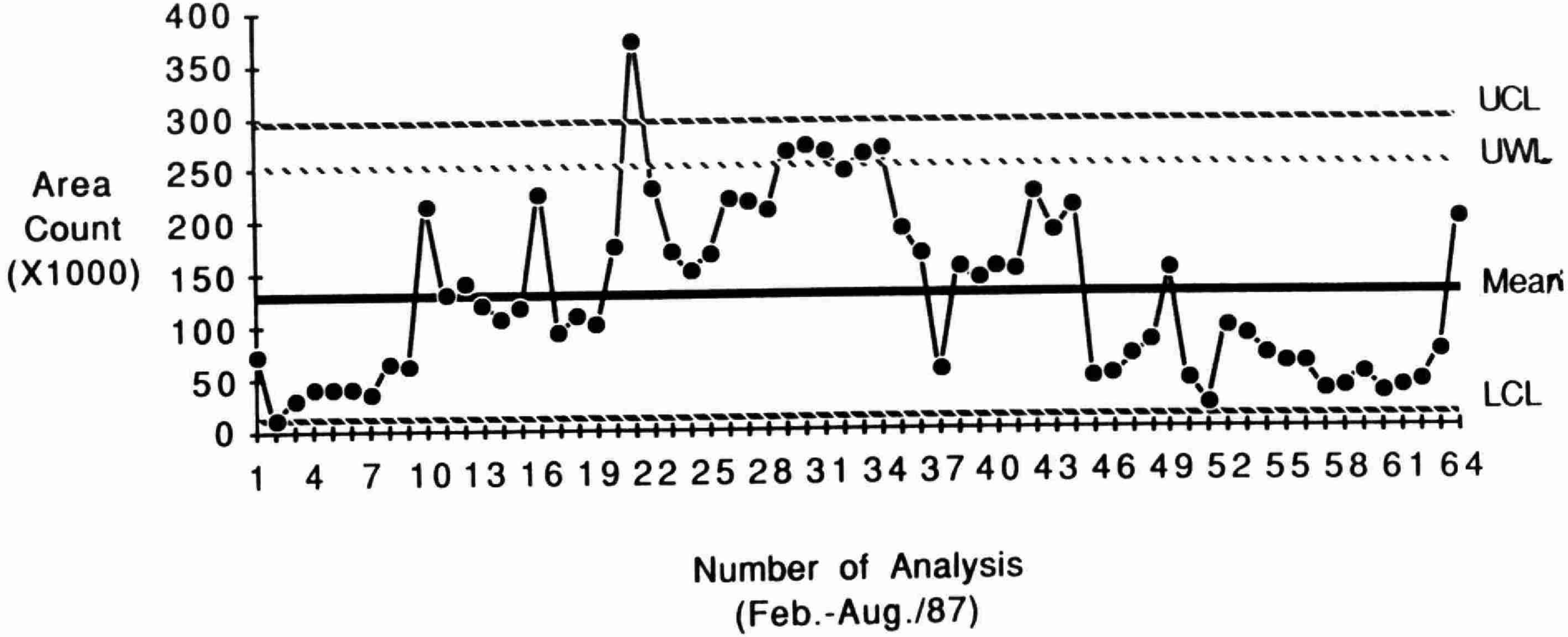


Fig. 2.2.2.8

**OA-INSTRUMENT RESPONSE CHART**
**(1,2-Dimethylbenzene-10ppb)**

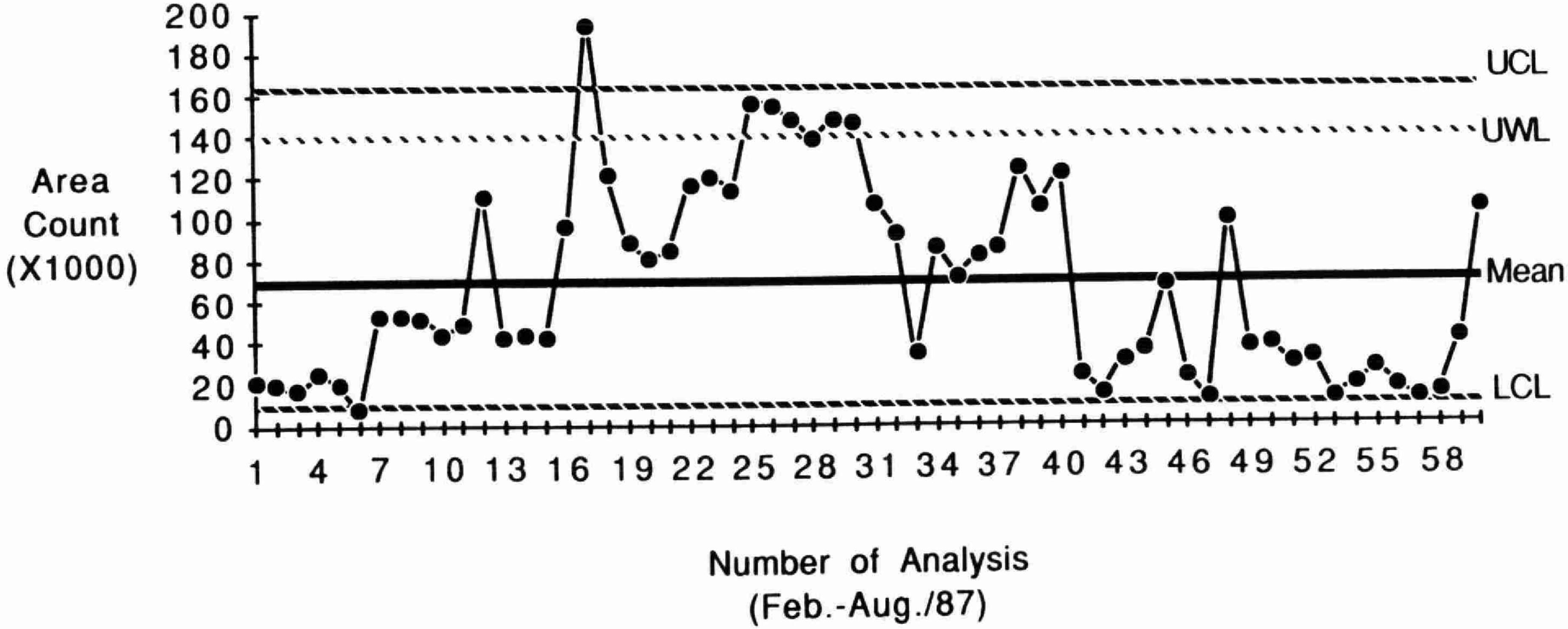


Fig. 2.2.2.9

**VOA-INSTRUMENT RESPONSE CHART**
**(3-Chloro-1-propene-10ppb)**

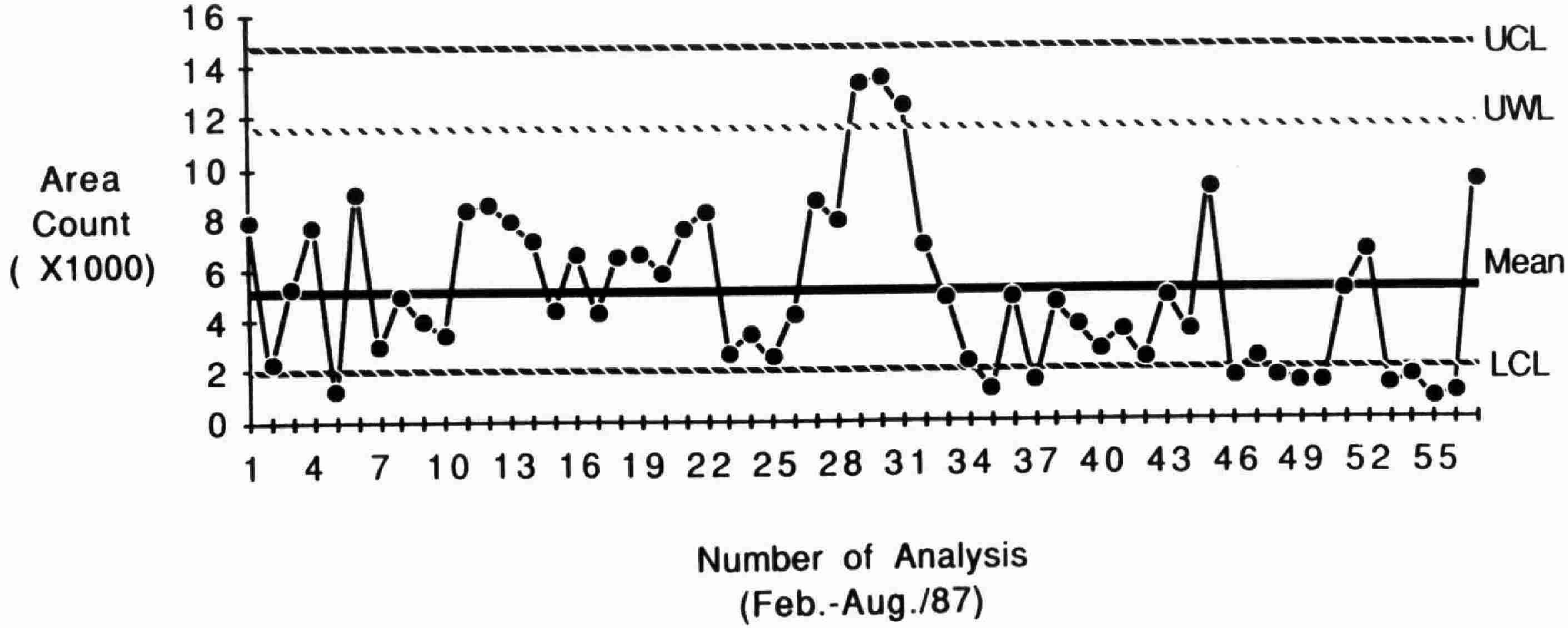


Fig. 2.2.2.10

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Primary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | ZE07-0008 | 91.8 | 96.7 | 97.4 | 93.8 |
| 2 | ZE07-0011 | 98.2 | 84.7 | 89.1 | 87.9 |
| 3 | ZE07-0059 | 89.8 | 81.4 | 81.2 | 84.3 |
| 4 | ZE08-0019 | 104 | 99.5 | 98.8 | 100 |
| 5 | ZE08-0025 | 104 | 122 | 117 | 117 |
| 6 | ZE09-0013 | 95.3 | 101 | 99.3 | 99.2 |
| 7 | ZE09-0024 | 105 | 114 | 118 | 113 |
| 8 | ZE12-0026 | 94 | 91.3 | 93.5 | 96.6 |
| 9 | ZE12-0030 | 116 | 98.7 | 99.7 | 105.9 |
| 10 | ZE13-0010 | 101 | 99.8 | 98.2 | 89.7 |
| 11 | ZE13-0012 | 106 | 93.6 | 100 | 96.9 |
| 12 | ZE14-0031 | 94 | 98.4 | 94.1 | 82.4 |
| 13 | ZE14-0033 | 104 | 101 | 91.6 | 77.9 |
| 14 | ZE14-0035 | 93.5 | 89.7 | 86.2 | 76.8 |
| 15 | ZE15-0002 | 97.3 | 96.7 | 96.4 | 72.3 |
| 16 | ZE15-0004 | 85.1 | 85.1 | 82.7 | 79 |
| 17 | ZE15-0002R | 42 * # | 39 * # | 101 | 89.3 |
| 18 | ZE19-0015 | 68 | 73 | 71 | 61 |
| 19 | ZE19-0017 | 86 | 110 | 89 | 81 |
| 20 | ZE19-0019 | 120 | 150 * # | 120 | 120 |
| 21 | ZE22-0005 | 110 | 68 | 91 | 120 |
| 22 | ZE22-0007 | 100 | 67 | 110 | 98 |
| 23 | ZE22-0009 | 69 | 54 * # | 72 | 61 |
| 24 | ZE22-0011 | 97 | 65 | 110 | 110 |
| 25 | ZE22-0013 | 110 | 59 * | 110 | 110 |
| 26 | ZE23-0027 | 89 | 88 | 96 | 110 |
| 27 | ZE23-0034 | 100 | 88 | 91 | 90 |
| 28 | ZE23-0034R | 110 | 110 | 94 | 96 |
| 29 | ZE23-0036 | 110 | 98 | 90 | 99 |
| 30 | ZE24-0003 | 81 | 85 | 82 | 93 |
| 31 | ZE24-0005 | 97 | 110 | 83 | 63 |
| 32 | ZE30-0037 | 106 | 106 | 107 | 101 |
| 33 | ZE30-0040 | 96 | 98 | 109 | 102 |
| 34 | ZE31-0006 | 84 | 95 | 75 | 85 |
| 35 | ZE31-0008 | 76 | 79 | 74 | 77 |
| 36 | ZE31-0011 | 109 | 92 | 105 | 104 |
| Average | | 97.1 | 92.3 | 95.1 | 92.9 |
| SD | | 12.2 | 14.7 | 12.8 | 15.8 |

QA/QC Action Limits for Surrogate Recovery: 60-120%
* ouside the QA/QC action limits
# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.1.1

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | ZE04-0002 | 113 * | 122.0 * | 126 * # | 121.0 * |
| 2 | ZE04-0004 | 88.8 | 97.1 | 92.5 | 95.8 |
| 3 | ZE04-0229 | 105 | 108 | 109 | 110 |
| 4 | ZE04-0231 | 91.4 | 101 | 96.5 | 99.1 |
| 5 | ZE04-0233 | 94.5 | 90.3 | 98.6 | 101 |
| 6 | ZE-04-0235 | 92.3 | 98.7 | 106 | 97.2 |
| 7 | ZE05-0002 | 86.1 | 110 | 113 | 95.6 |
| 8 | ZE05-0004 | 72.6 | 100 | 103 | 87.6 |
| 9 | ZE05-0008 | 89.9 | 91.3 | 91.6 | 92.7 |
| 10 | ZE05-0010 | 88.4 | 95.2 | 94.8 | 96.8 |
| 11 | ZE05-0012 | 86.4 | 96.2 | 91.8 | 93.8 |
| 12 | ZE05-0014 | 132 * | 94.5 | 114 | 116 |
| 13 | ZE05-0016 | 80.6 | 93.1 | 95.6 | 92.8 |
| 14 | ZE05-0024 | 98 | 94.3 | 93.8 | 98.3 |
| 15 | ZE05-0036 | 82.8 | 92.5 | 98.2 | 98.3 |
| 16 | ZE05-0038 | 78.3 | 83.9 | 87.5 | 86.2 |
| 17 | ZE05-0040 | 72.4 | 74.7 | 80.7 | 78.1 |
| 18 | ZE06-0002 | 68.2 | 75.2 | 78.9 | 77.7 |
| 19 | ZE06-0004 | 71.1 | 78.3 | 82.5 | 81.2 |
| 20 | ZE07-0002 | 76.3 | 71.9 | 57.9 * # | 62.6 |
| 21 | ZE07-0004 | 78 | 77.6 | 81.2 | 78.1 |
| 22 | ZE07-0006 | 67.3 | 87 | 83.9 | 82.8 |
| 23 | ZE07-0013 | 89.2 | 89.8 | 92.2 | 93 |
| 24 | ZE07-0016 | 95 | 90.4 | 90.1 | 92.5 |
| 25 | ZE07-0018 | 88.4 | 97.4 | 92.9 | 94.3 |
| 26 | ZE07-0021 | 96.9 | 94.8 | 95.8 | 94.3 |
| 27 | ZE07-0023 | 93.7 | 88.6 | 90.8 | 89.8 |
| 28 | ZE07-0025 | 116 | 130 * | 124 * # | 129.0 * |
| 29 | ZE07-0027 | 128 * | 120 | 112 | 120 |
| 30 | ZE07-0039 | 60.6 | 76 | 78.2 | 80.3 |
| 31 | ZE07-0041 | 137 * # | 124 * | 111 | 120 |
| 32 | ZE07-0043 | 99.3 | 100 | 106 | 102 |
| 33 | ZE07-0045 | 119 | 113 | 96.1 | 105 |
| 34 | ZE07-0053 | 113 | 115 | 101 | 110 |
| 35 | ZE07-0069 | 84.2 | 99 | 99.3 | 100 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

Project ID: AN873095

Analyst: TC

Instrument: GC/MS

Analysis Date: Feb.-Aug./87

Matrix Type: Secondary Final Effluent

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 36 | ZE07-0072 | 90 | 111 | 107 | 108 |
| 37 | ZE07-0075 | 80.9 | 92.8 | 97 | 96.5 |
| 38 | ZE08-0002 | 73.3 | 77.4 | 73.9 | 78.3 |
| 39 | ZE08-0005 | 98.7 | 101 | 91.9 | 95.9 |
| 40 | ZE08-0027 | 91.4 | 84.9 | 88 | 88.3 |
| 41 | ZE08-0029 | 122 * | 131 * | 129 * # | 129 * |
| 42 | ZE08-0033 | 79.1 | 83.4 | 83.9 | 82.9 |
| 43 | ZE08-0035 | 137 * # | 148 * # | 139 * # | 145 * # |
| 44 | ZE08-0038 | 117 | 126 * | 119 | 122 * |
| 45 | ZE08-0040 | 89 | 87.6 | 88.4 | 86.2 |
| 46 | ZE08-0045 | 84.6 | 81.7 | 87 | 85.9 |
| 47 | ZE09-0005 | 94.7 | 97.2 | 93.1 | 99.2 |
| 48 | ZE09-0007 | 89.3 | 87.2 | 91.4 | 88.8 |
| 49 | ZE09-0015 | 88.1 | 91.1 | 93.1 | 88.8 |
| 50 | ZE09-0022 | 99.7 | 109 | 102 | 102 |
| 51 | ZE09-0031 | 92.1 | 99.3 | 106 | 107 |
| 52 | ZE09-0044 | 97.9 | 104 | 105 | 104 |
| 53 | ZE09-0047 | 87.3 | 94.2 | 100 | 104 |
| 54 | ZE09-0050 | 64.9 | 73 | 79.2 | 75.2 |
| 55 | ZE10-0002 | 111 | 100 | 104 | 101 |
| 56 | ZE10-0005 | 85.6 | 97.4 | 94 | 97.3 |
| 57 | ZE10-0019 | 95.9 | 116 | 104 | 110 |
| 58 | ZE10-0021 | 89.1 | 93.4 | 97.7 | 95.1 |
| 59 | ZE10-0023 | 94 | 112 | 110 | 108 |
| 60 | ZE10-0025 | 90.7 | 99.5 | 101 | 101 |
| 61 | ZE10-0027 | 85.6 | 92.4 | 97.1 | 96.7 |
| 62 | ZE11-0002 | 105 | 99.7 | 101 | 107 |
| 63 | ZE11-0004 | 103 | 105 | 103 | 114 |
| 64 | ZE11-0010 | 109 | 83.3 | 99.6 | 95.6 |
| 65 | ZE11-0012 | 122 * | 126 * | 102 | 84.6 |
| 66 | ZE11-0020 | 90.9 | 134 * | 110 | 92.2 |
| 67 | ZE11-0022 | 105 | 92.5 | 89.2 | 75.3 |
| 68 | ZE11-0024 | 122 * | 108 | 97 | 80.9 |
| 69 | ZE11-0026 | 121 | 112 | 103 | 80.2 |
| 70 | ZE11-0028 | 118 | 112 | 106 | 85.3 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 71 | ZE11-0030 | 95.9 | 94.6 | 96.8 | 73.1 |
| 72 | ZE12-0002 | 116 | 26.6 * # | 105 | 94.4 |
| 73 | ZE12-0004 | 94 | 94.1 | 95.9 | 84.3 |
| 74 | ZE12-0012 | 145 * # | 107 | 93.5 | 70.8 |
| 75 | ZE12-0014 | 129 * | 98.2 | 84.3 | 68.4 |
| 76 | ZE12-0020 | 96.4 | 110 | 115 | 111 |
| 77 | ZE12-0020R | 90.1 | 26.7 * # | 94.2 | 90.9 |
| 78 | ZE12-0032 | 100 | 102 | 89.5 | 89 |
| 79 | ZE12-0034 | 103 | 29 * # | 88.7 | 86.9 |
| 80 | ZE12-0036 | 119 | 31.9 * # | 112 | 114 |
| 81 | ZE13-0002 | 104 | 95.6 | 91.7 | 105 |
| 82 | ZE13-0004 | 104 | 145 * # | 114 | 133 * |
| 83 | ZE13-0018 | 86.8 | 211 * # | 83.3 | 78.1 |
| 84 | ZE13-0020 | 101 | 90 | 86 | 130 * |
| 85 | ZE13-0026 | 94.5 | 91.1 | 90.2 | 65.9 |
| 86 | ZE13-0020R | 97.8 | 98.2 | 78 | 122 * |
| 87 | ZE13-0031 | 123 * | 118 | 109 | 121 * |
| 88 | ZE13-0033 | 116 | 288 * # | 108 | 116 |
| 89 | ZE13-0035 | 85.2 | 101 | 90.5 | 81.6 |
| 90 | ZE13-0037 | 77.6 | 77.3 | 83.6 | 77.5 |
| 91 | ZE13-0038 | 81.5 | 73.2 | 86.1 | 81.1 |
| 92 | ZE13-0040 | 90.2 | 355 * # | 94.4 | 114 |
| 93 | ZE13-0041 | 88.4 | 92.6 | 93.6 | 88.5 |
| 94 | ZE13-0044 | 89.2 | 117 | 95.8 | 94.3 |
| 95 | ZE13-0033R | 128 * | 289 * # | 106 | 120 |
| 96 | ZE13-0035R | 121 * | 112 | 113 | 111 |
| 97 | ZE14-0002 | 107 | 144 * # | 80.6 | 73.7 |
| 98 | ZE14-0021 | 84.5 | 96.2 | 79.9 | 83.2 |
| 99 | ZE14-0023 | 83.2 | 24 * # | 83.2 | 76.4 |
| 100 | ZE14-0025 | 103 | 99.2 | 135 * # | 198 * # |
| 101 | ZE14-0010 | 144 * # | 125 * | 119 | 164 * # |
| 102 | ZE14-0011 | 128 * | 112 | 91 | 141 * # |
| 103 | ZE14-0013 | 104 | 61.4 | 89.7 | 73.1 |
| 104 | ZE14-0014 | 82 | 94.7 | 78.9 | 84 |
| 105 | ZE15-0010 | 102 | 98.8 | 97.5 | 87.2 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 106 | ZE15-0012 | 91.3 | 91.3 | 90 | 77.7 |
| 107 | ZE17-0004 | 95 | 93 | 89 | 99 |
| 108 | ZE17-0006 | 82 | 88 | 84 | 94 |
| 109 | ZE17-0008 | 87 | 90 | 82 | 94 |
| 110 | ZE17-0010 | 170 * # | 170 * # | 160 * # | 150 * # |
| 111 | ZE17-0012 | 87 | 85 | 84 | 87 |
| 112 | ZE17-0014 | 78 | 85 | 96 | 85 |
| 113 | ZE17-0016 | 89 | 87 | 86 | 92 |
| 114 | ZE17-0002R | 110 | 110 | 110 | 110 |
| 115 | ZE17-0018 | 96 | 96 | 88 | 98 |
| 116 | ZE18-0004 | 91 | 95 | 92 | 100 |
| 117 | ZE18-0006 | 92 | 100 | 92 | 93 |
| 118 | ZE18-0014 | 93 | 99 | 87 | 92 |
| 119 | ZE18-0008 | 89 | 92 | 90 | 91 |
| 120 | ZE18-0021 | 87 | 88 | 85 | 84 |
| 121 | ZE18-0023 | 93 | 96 | 92 | 92 |
| 122 | ZE19-0002 | 120 | 120 | 120 | 110 |
| 123 | ZE19-0003 | 130 * | 130 * | 110 | 110 |
| 124 | ZE19-0005 | 90 | 110 | 100 | 110 |
| 125 | ZE19-0006 | 72 | 59 | 71 | 74 |
| 126 | ZE19-0011 | 100 | 80 | 98 | 100 |
| 127 | ZE19-0012 | 94 | 35 * # | 100 | 97 |
| 128 | ZE20-0010 | 88 | 84 | 140 * # | 110 |
| 129 | ZE20-0011 | 93 | 91 | 82 | 88 |
| 130 | ZE20-0014 | 90 | 92 | 88 | 84 |
| 131 | ZE20-0013 | 79 | 85 | 84 | 81 |
| 132 | ZE20-0021 | 94 | 92 | 89 | 100 |
| 133 | ZE20-0025 | 100 | 93 | 93 | 57 * |
| 134 | ZE20-0027 | 91 | 94 | 87 | 97 |
| 135 | ZE20-0029 | 87 | 96 | 85 | 100 |
| 136 | ZE20-0031 | 100 | 100 | 110 | 100 |
| 137 | ZE21-0002 | 91 | 92 | 64 | 79 |
| 138 | ZE21-0004 | 110 | 98 | 100 | 100 |
| 139 | ZE21-0006 | 98 | 99 | 90 | 100 |
| 140 | ZE21-0008 | 87 | 98 | 89 | 97 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 141 | ZE21-0014 | 96 | 110 | 82 | 100 |
| 142 | ZE21-0022 | 97 | 140 * | 92 | 41 * # |
| 143 | ZE21-0024 | 58 * | 84 | 60 | 95 |
| 144 | ZE21-0026 | 100 | 25 * # | 85 | 72 |
| 145 | ZE21-0028 | 81 | 73 | 80 | 56 * |
| 146 | ZE21-0030 | 77 | 120 | 84 | 110 |
| 147 | ZE21-0032 | 97 | 110 | 77 | 100 |
| 148 | ZE21-0033 | 99 | 95 | 130 * # | 100 |
| 149 | ZE21-0034 | 90 | 86 | 77 | 91 |
| 150 | ZE22-0002 | 110 | INT | 110 | 120 |
| 151 | ZE22-0019 | 110 | 120 | 110 | 110 |
| 152 | ZE22-0030 | 120 | 110 | 120 | 86 |
| 153 | ZE22-0030R | 130 * # | 110 | 100 | 110 |
| 154 | ZE22-0036 | 83 | 100 | 91 | 92 |
| 155 | ZE22-0039 | 100 | 100 | 75 | 100 |
| 156 | ZE22-0042 | 96 | 110 | 91 | 100 |
| 157 | ZE22-0044 | 100 | 100 | 94 | 100 |
| 158 | ZE22-0041 | 100 | 120 | 100 | 84 |
| 159 | ZE23-0002 | 99 | 100 | 110 | 100 |
| 160 | ZE23-0004 | 98 | 120 | 100 | 100 |
| 161 | ZE23-0006 | 100 | 88 | 98 | 97 |
| 162 | ZE23-0008 | 51 * # | 34 * # | 57 * # | 54 * |
| 163 | ZE23-0010 | 89 | 0 * # | 92 | 110 |
| 164 | ZE23-0012 | 180 | 220 * # | 110 | 130 |
| 165 | ZE23-0017 | 87 | 110 | 100 | 110 |
| 166 | ZE23-0019 | 100 | 110 | 100 | 120 |
| 167 | ZE23-0025 | 99 | 89 | 100 | 100 |
| 168 | ZE24-0013 | 110 | 0 * # | 110 | 110 |
| 169 | ZE24-0017 | 93 | 58 * | 100 | 110 |
| 170 | ZE24-0019 | 120 | 160 * # | 120 | 110 |
| 171 | ZE24-0021 | 100 | 94 | 96 | 90 |
| 172 | ZE24-0023 | 85 | 0 * # | 88 | 120 |
| 173 | ZE25-0002 | 120 | 0 * # | 120 | 120 |
| 174 | ZE25-0004 | 96 | 78 | 85 | 100 |
| 175 | ZE25-0010 | 93 | 84 | 100 | 93 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 176 | ZE25-0012 | 87 | 84 | 92 | 87 |
| 177 | ZE25-0019 | 105 | 107 | 94 | 128 |
| 178 | ZE25-0021 | 80 | 89 | 87 | 88 |
| 179 | ZE25-0023 | 84 | 74 | 83 | 93 |
| 180 | ZE26-0002 | 104 | 0 * # | 113 | 109 |
| 181 | ZE26-0004 | 93 | 111 | 108 | 107 |
| 182 | ZE26-0016 | 74 | 76 | 78 | 88 |
| 183 | ZE26-0018 | 86 | 67 | 75 | 82 |
| 184 | ZE26-0020 | 104 | 125 * | 100 | 125 * |
| 185 | ZE26-0022 | 120 | 80 | 120 | 132 * |
| 186 | ZE26-0025 | 124 * | 107 | 135 * # | 136 * |
| 187 | ZE27-0003 | 123 * | 58 * | 122 * | 87 |
| 188 | ZE27-0003R | 106 | 128 * | 98 | 86 |
| 189 | ZE27-0011 | 72 | 78 | 74 | 61 |
| 190 | ZE27-0013 | 75 | 0 * # | 84 | 158 * # |
| 191 | ZE27-0015 | 83 | 142 * | 96 | 124 * |
| 192 | ZE27-0021 | 78 | 41 * # | 62 | 63 |
| 193 | ZE27-0027 | 86 | 159 * # | 91 | 71 |
| 194 | ZE27-0032 | 102 | 94 | 95 | 76 |
| 195 | ZE27-0035 | 89 | 158 * # | 87 | 107 |
| 196 | ZE28-0002 | 88 | 87 | 86 | 85 |
| 197 | ZE28-0004 | 78 | 87 | 94 | 95 |
| 198 | ZE28-0026 | 103 | 88 | 106 | 96 |
| 199 | ZE28-0028 | 75 | 69 | 74 | 76 |
| 200 | ZE28-0010 | 100 | 100 | 108 | 115 |
| 201 | ZE28-0012 | 96 | 93 | 90 | 94 |
| 202 | ZE28-0030 | 91 | 115 | 105 | 105 |
| 203 | ZE28-0014 | 95 | 41 * # | 92 | 89 |
| 204 | ZE28-0017 | 118 | 126 * | 112 | 117 |
| 205 | ZE28-0032 | 110 | 110 | 97 | 100 |
| 206 | ZE28-0034 | 130 * | 88 | 100 | 86 |
| 207 | ZE28-0036 | 95 | 88 | 93 | 93 |
| 208 | ZE28-0038 | 86 | 79 | 86 | 88 |
| 209 | ZE28-0040 | 85 | 97 | 87 | 99 |
| 210 | ZE28-0042 | 71 | 100 | 96 | 100 |

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Secondary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 211 | ZE28-0013 | 109 | 87 | 98 | 90 |
| 212 | ZE29-0002 | 123 * | 104 | 106 | 108 |
| 213 | ZE29-0004 | 84 | 103 | 108 | 103 |
| 214 | ZE29-0004R | 90 | 109 | 99 | 103 |
| 215 | ZE29-0010 | 78 | 103 | 87 | 95 |
| 216 | ZE29-0017 | 119 | 108 | 114 | 114 |
| 217 | ZE29-0019 | 59 * | 87 | 84 | 88 |
| 218 | ZE29-0026 | 80 | 98 | 76 | 93 |
| 219 | ZE29-0029 | 123 * | 116 | 114 | 127 |
| 220 | ZE29-0031 | 79 | 81 | 89 | 88 |
| 221 | ZE30-0002 | 75 | 81 | 82 | 95 |
| 222 | ZE30-0004 | 81 | 80 | 73 | 77 |
| 223 | ZE30-0016 | 105 | 103 | 97 | 103 |
| 224 | ZE30-0019 | 98 | 110 | 116 | 117 |
| 225 | ZE30-0022 | 145 * # | 127 * | 150 * # | 152 * # |
| 226 | ZE30-0028 | 117 | 118 | 104 | 118 |
| 227 | ZE30-0030 | 89 | 85 | 94 | 87 |
| 228 | ZE31-0027 | 96 | 96 | 96 | 98 |
| 229 | ZE31-0029 | 85 | 91 | 78 | 83 |
| 230 | ZE31-0035 | 79 | 75 | 71 | 74 |
| 231 | ZE31-0037 | 95 | 76 | 83 | 90 |
| 232 | ZE31-0040 | 90 | 64 | 92 | 89 |
| 233 | ZE31-0043 | 81 | 74 | 78 | 81 |
| | | | | | |
| Average | | 96 | 97 | 94 | 96 |
| SD | | 16 | 16 | 12 | 16 |

QA/QC Action Limits for Surrogate Recove 60-120%
* ouside the QA/QC action limits
# outlier, not included in calculation

Table 2.2.3.1.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Return Recycle | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | ZE07-0009 | 90.5 | 103 | 126 * # | 114 |
| 2 | ZE07-0014 | 124 * | 112 | 106 | 113 |
| 3 | ZE07-0019 | 117 | 109 | 108 | 115 |
| 4 | ZE07-0019R | 97.1 | 105 | 98.8 | 98.9 |
| 5 | ZE07-0034 | 121 * | 110 | 89.3 | 103 |
| 6 | ZE07-0037 | 127 * | 110 | 94.3 | 99.4 |
| 7 | ZE07-0046 | 150 * | 150 * # | 119 | 123 * |
| 8 | ZE07-0060 | 97.7 | 105 | 97.8 | 98.5 |
| 9 | ZE07-0070 | 88.8 | 98 | 95.2 | 95 |
| 10 | ZE07-0073 | 80.9 | 98.1 | 93 | 95.9 |
| 11 | ZE07-0076 | 89.5 | 95.1 | 96.2 | 99.3 |
| 12 | ZE08-0003 | 90.4 | 97.1 | 86.3 | 89.4 |
| 13 | ZE08-0018 | 160.6 * # | 188.7 * # | 200.4 * # | 189.8 * # |
| 14 | ZE08-0021 | 96.2 | 107 | 102 | 110 |
| 15 | ZE08-0024 | 144 * | 135 * | 129 * | 132 * # |
| 16 | ZE08-0038 | 117 | 126 * | 119 | 122 * |
| 17 | ZE09-0003 | 105 | 113 | 111 | 108 |
| 18 | ZE09-0012 | 95 | 88.1 | 82.4 | 86.3 |
| 19 | ZE09-0045 | 96.1 | 94.2 | 97.8 | 96.9 |
| 20 | ZE09-0048 | 143 * | 65 | 97.3 | 102 |
| 21 | ZE09-0051 | 95.1 | 108 | 103 | 103 |
| 22 | ZE10-0003 | 90 | 83.8 | 94.1 | 82.6 |
| 23 | ZE10-0006 | 101 | 101 | 98.6 | 102 |
| 24 | ZEX21-0033 | 99 | 95 | 130 * # | 100 |
| 25 | ZE22-0003 | 95 | 0 * # | 100 | 100 |
| 26 | ZE22-0020 | 100 | 49 # | 87 | 100 |
| 27 | ZE22-0023 | 120 | 59 | 99 | 87 |
| 28 | ZE22-0040 | 99 | 99 | 100 | 75 # |
| 29 | ZE22-0045 | 100 | 99 | 110 | 110 |
| 30 | ZE22-0050 | 110 | 130 * | 97 | 110 |
| 31 | ZE27-0034 | 98 | 149 * # | 103 | 97 |
| 32 | ZE27-0030 | 94 | 0 * # | 101 | 101 |
| 33 | ZE27-0033 | 66 | 67 | 81 | 81 |
| 34 | ZE27-0036 | 109 | 61 | 117 | 101 |
| 35 | ZE28-0015 | 100 | 83 | 98 | 101 |
| 36 | ZE28-0018 | 95 | 110 | 97 | 94 |
| 37 | ZE30-0021 | 117 | 125 * | 96 | 124 * |
| 38 | ZE30-0015 | 82 | 88 | 79 | 87 |
| 39 | ZE30-0018 | 102 | 106 | 96 | 105 |
| 40 | ZE30-0038 | 89 | 93 | 109 | 100 |

Table 2.2.3.1.3

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Return Recycle | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 41 | ZE31-0009 | 80 | 98 | 80 | 90 |
| 42 | ZE31-0012 | 123 * | 148 * # | 114 | 122 * |
| 43 | ZE31-0039 | 107 | 93 | 108 | 114 |
| 44 | ZE31-0042 | 92 | 91 | 93 | 98 |
| | | | | | |
| Average | | 103.1 | 98.9 | 99.6 | 101.9 |
| S.D. | | 17.5 | 17.4 | 10.9 | 10.8 |

QA/QC Action Limits for Surrogate Recovery: 40-120%
* outside the QA/QC action limits
# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.1.3

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Raw Sewage | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | ZE04-0001 | 96.1 | 94.6 | 89.5 | 94.8 |
| 2 | ZE04-0003 | 109 | 110 | 113 | 112 |
| 3 | ZE04-0228 | 110 | 114 | 121.0 * | 117 |
| 4 | ZE04-0230 | 107 | 111 | 107 | 111 |
| 5 | ZE05-0007 | 105 | 100 | 102 | 101 |
| 6 | ZE05-0013 | 109 | 112 | 110 | 112 |
| 7 | ZE05-0035 | 88.8 | 102 | 96.3 | 101 |
| 8 | ZE05-0037 | 107 | 109 | 104 | 107 |
| 9 | ZE05-0039 | 103 | 112 | 104 | 105 |
| 10 | ZE06-0001 | 83.8 | 92.1 | 87.7 | 86.2 |
| 11 | ZE06-0003 | 154 * # | 169 * # | 157 * # | 166 * # |
| 12 | ZE07-0001 | 111 | 102 | 100 | 130 * |
| 13 | ZE07-0003 | 81.9 | 93.8 | 106 | 105 |
| 14 | ZE07-0005 | 74.1 | 87.2 | 102 | 102 |
| 15 | ZE07-0007 | 94.6 | 93.4 | 91.7 | 93.4 |
| 16 | ZE07-0010 | 79.1 | 79.8 | 81.4 | 90 |
| 17 | ZE07-0012 | 76.5 | 81.1 | 82.3 | 80.2 |
| 18 | ZE07-0015 | 101 | 102 | 103 | 81.5 |
| 19 | ZE07-0017 | 99.6 | 105 | 105 | 103 |
| 20 | ZE07-0020 | 109 | 100 | 103 | 108 |
| 21 | ZE07-0024 | 112 | 108 | 102 | 102 |
| 22 | ZE07-0026 | 98.7 | 102 | 98.3 | 105 |
| 23 | ZE07-0038 | 75.3 | 78.9 | 89.7 | 101 |
| 24 | ZE07-0040 | 69.5 | 71 | 86 | 84.7 |
| 25 | ZE07-0042 | 74.6 | 86.3 | 94.4 | 81.2 |
| 26 | ZE07-0044 | 92.6 | 82.7 | 112 | 91.5 |
| 27 | ZE07-0058 | 98.2 | 90.9 | 93 | 90.6 |
| 28 | ZE07-0068 | 102 | 110 | 97.3 | 94.1 |
| 29 | ZE07-0071 | 87.7 | 97.6 | 92.7 | 106 |
| 30 | ZE07-0074 | 99.9 | 106 | 92.7 | 94.2 |
| 31 | ZE08-0001 | 89.3 | 101 | 93.7 | 99.3 |
| 32 | ZE08-0004 | 67.6 | 73.4 | 91.6 | 103 |
| 33 | ZE08-0017 | 91.8 | 97.5 | 91.4 | 78.7 |
| 34 | ZE08-0020 | 109 | 120 | 108 | 91.4 |
| 35 | ZE08-0023 | 91.3 | 97.1 | 93.7 | 110 |
| 36 | ZE08-0026 | 88 | 90.2 | 89.2 | 95.1 |
| 37 | ZE08-0028 | 100 | 94.8 | 92.4 | 91.6 |
| 38 | ZE08-0032 | 136 * | 139 * | 141 * # | 93.9 |
| 39 | ZE08-0034 | 103 | 99.1 | 94.5 | 130 * |
| 40 | ZE08-0036 | 95.2 | 92.2 | 94.3 | 94.3 |

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

Project ID: AN873095 | Analyst: TC

Instrument: GC/MS | Analysis Date: Feb.-Aug./87

Matrix Type: Raw Sewage

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 41 | ZE08-0039 | 93.8 | 87.9 | 87.4 | 91.4 |
| 42 | ZE08-0041 | 100 | 97 | 116 | 87.6 |
| 43 | ZE09-0001 | 138 * | 74.9 | 104 | 109 |
| 44 | ZE09-0004 | 95.1 | 98.1 | 91.4 | 103 |
| 45 | ZE09-0006 | 105 | 121 * | 114 | 93 |
| 46 | ZE09-0011 | 107 | 123 * | 111 | 107 |
| 47 | ZE09-0014 | 96.8 | 98.4 | 96.8 | 111 |
| 48 | ZE09-0021 | 110 | 117 | 107 | 93.2 |
| 49 | ZE09-0023 | 90.9 | 95.1 | 93.9 | 110 |
| 50 | ZE09-0030 | 94.1 | 97.2 | 94 | 89.9 |
| 51 | ZE09-0043 | 93.7 | 99.1 | 102 | 93.6 |
| 52 | ZE09-0046 | 109 | 114 | 107 | 101 |
| 53 | ZE09-0049 | 95.8 | 97.2 | 92.8 | 109 |
| 54 | ZE10-0001 | 95.8 | 100 | 99.8 | 91.6 |
| 55 | ZE10-0004 | 118 | 112 | 109 | 99.6 |
| 56 | ZE10-0018 | 81.1 | 88.1 | 95.8 | 106 |
| 57 | ZE10-0020 | 100 | 108 | 107 | 92 |
| 58 | ZE10-0022 | 101 | 113 | 115 | 103 |
| 59 | ZE10-0024 | 83.8 | 103 | 107 | 110 |
| 60 | ZE10-0026 | 101 | 124 * | 121 * | 99.3 |
| 61 | ZE11-0001 | 94.4 | 95 | 92.5 | 122 * |
| 62 | ZE11-0003 | 101 | 112 | 109 | 105 |
| 63 | ZE11-0009 | 91.8 | 96.9 | 96.3 | 118 |
| 64 | ZE11-0011 | 90.7 | 273 * # | 97.1 | 108 |
| 65 | ZE11-0019 | 101 | 94.4 | 90.4 | 106 |
| 66 | ZE11-0021 | 104 | 100 | 97.3 | 112 |
| 67 | ZE11-0023 | 62.5 | 92.8 | 89.2 | 127 * |
| 68 | ZE12-0001 | 111 | 107 | 113 | 99.8 |
| 69 | ZE12-0003 | 103 | 92.5 | 96.5 | 104 |
| 70 | ZE12-0019 | 106 | 101 | 94.5 | 92 |
| 71 | ZE12-0021 | 97.8 | 89.2 | 90.9 | 101 |
| 72 | ZE12-0021R | 98.1 | 94.5 | 100 | 88.4 |
| 73 | ZE12-0023 | 107 | 113 | 109 | 104 |
| 74 | ZE12-0025 | 96.5 | 29.6 * # | 91.1 | 110 |
| 75 | ZE12-0027 | 114 | 111 | 110 | 101 |
| 76 | ZE12-0029 | 113 | 112 | 114 | 111 |
| 77 | ZE12-0031 | 116 | 82.5 | 111 | 95.8 |
| 78 | ZE12-0033 | 104 | 112 | 101 | 119 |
| 79 | ZE12-0035 | 104 | 29.6 * # | 101 | 109 |
| 80 | ZE13-0001 | 109 | 86.4 | 106 | 91.7 |

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Raw Sewage | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 81 | ZE13-0003 | 108 | 89.3 | 108 | 105 |
| 82 | ZE13-0009 | 97.6 | 288 * # | 105 | 101 |
| 83 | ZE13-0011 | 99.1 | 90.4 | 97.3 | 93 |
| 84 | ZE13-0017 | 94.6 | 285 * # | 99.2 | 99.3 |
| 85 | ZE13-0019 | 90.6 | 288 * # | 97.4 | 100 |
| 86 | ZE13-0025 | 120 | 102 | 108 | 99 |
| 87 | ZE13-0025R | 50.9# | 28.5 * # | 92.5 | 80.2 |
| 88 | ZE13-0030 | 126 | 59 | 98.8 | 103 |
| 89 | ZE13-0032 | 86.4 | 101 | 93.9 | 86.4 |
| 90 | ZE13-0034 | 120 | 108 | 108 | 86.4 |
| 91 | ZE13-0036 | 96.5 | 102 | 92.6 | 142 * # |
| 92 | ZE13-0039 | 92.7 | 87.5 | 89.2 | 134 * # |
| 93 | ZE13-0042 | 90.3 | 103 | 94.9 | 54.8 |
| 94 | ZE14-0001 | 116 | 134 * | 101 | 135 * # |
| 95 | ZE14-0007 | 118 | 158 * # | 97.2 | 94.3 |
| 96 | ZE14-0009 | 156 * # | 57.6 | 113 | 87.3 |
| 97 | ZE14-0024 | 103 | 118 | 96.2 | 132 * |
| 98 | ZE14-0022 | 105 | 121 * | 100 | 102 |
| 99 | ZE14-0030 | 119 | 121 * | 118 | 104 |
| 100 | ZE14-0032 | 91 | 132 * | 120 | 105 |
| 101 | ZE14-0034 | 110 | 107 | 107 | 124 * |
| 102 | ZE14-0012 | 113 | 35.5 * # | 105 | 101 |
| 103 | ZE15-0001 | 97.6 | 111 | 94.6 | 84 |
| 104 | ZE15-0003 | 93.1 | 97.7 | 88.5 | 178 * # |
| 105 | ZE15-0009 | 85.1 | 89.6 | 86 | 79 |
| 106 | ZE15-0011 | 102.4 | 99.6 | 97.2 | 66.7 |
| 107 | ZE17-0007 | 81 | 80 | 110 | 86.3 |
| 108 | ZE17-0009 | 110 | 110 | 86 | 88 |
| 109 | ZE17-0011 | 100 | 110 | 100 | 110 |
| 110 | ZE17-0013 | 89 | 88 | 91 | 110 |
| 111 | ZE17-0017 | 110 | 100 | 100 | 88 |
| 112 | ZE18-0003 | 96 | 92 | 90 | 98 |
| 113 | ZE18-0005 | 100 | 110 | 110 | 92 |
| 114 | ZE18-0013 | 92 | 100 | 93 | 110 |
| 115 | ZE18-0020 | 96 | 100 | 100 | 98 |
| 116 | ZE18-0022 | 100 | 99 | 97 | 97 |
| 117 | ZE18-0022R | 100 | 110 | 100 | 95 |
| 118 | ZE19-0001 | 110 | 110 | 110 | 99 |
| 119 | ZE19-0004 | 96 | 100 | 99 | 110 |
| 120 | ZE19-0010 | 120 | 130 * | 110 | 110 |

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Raw Sewage | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 121 | ZE19-0014 | 110 | 120 | 110 | 130 |
| 122 | ZE19-0016 | 110 | 84 | 100 | 110 |
| 123 | ZE20-0001 | 82 | 96 | 85 | 100 |
| 124 | ZE20-0009 | 98 | 110 | 97 | 95 |
| 125 | ZE20-0012 | 100 | 100 | 90 | 110 |
| 126 | ZE20-0020 | 96 | 99 | 92 | 90 |
| 127 | ZE20-0024 | 82 | 85 | 77 | 100 |
| 128 | ZE20-0026 | 92 | 110 | 93 | 94 |
| 129 | ZE20-0028 | 86 | 98 | 84 | 99 |
| 130 | ZE20-0030 | 100 | 100 | 86 | 96 |
| 131 | ZE21-0001 | 100 | 100 | 86 | 100 |
| 132 | ZE21-0003 | 96 | 100 | 100 | 100 |
| 133 | ZE21-0005 | 110 | 110 | 110 | 93 |
| 134 | ZE21-0007 | 96 | 94 | 100 | 110 |
| 135 | ZE21-0013 | 110 | 98 | 100 | 97 |
| 136 | ZE21-0027 | 120 | 150 * # | 87 | 100 |
| 137 | ZE21-0021 | 101 | 123 | 79 | 72 |
| 138 | ZE21-0023 | 77 | 82 | 116 | 34 * # |
| 139 | ZE21-0025 | 44 * # | 54 | 76 | 92 |
| 140 | ZE21-0029 | 98 | 38 * # | 98 | 84 |
| 141 | ZE21-0029R | 98 | 103 | 99 | 63 |
| 142 | ZE22-0004 | 92 | 39 * # | 90 | 103 |
| 143 | ZE22-0006 | 92 | 61 | 110 | 91 |
| 144 | ZE22-0008 | 100 | 54 | 95 | 98 |
| 145 | ZE22-0010 | 78 | 55 | 77 | 96 |
| 146 | ZE22-0012 | 91 | 89 | 99 | 84 |
| 147 | ZE22-0018 | 53# | 0 * # | 89 | 100 |
| 148 | ZE22-0021 | 120 | 66 | 110 | 150 * # |
| 149 | ZE22-0029 | 100 | 100 | 94 | 84 |
| 150 | ZE22-0035 | 100 | 99 | 110 | 76 |
| 151 | ZE23-0001 | 98 | 99 | 100 | 95 |
| 152 | ZE23-0003 | 82 | 120 | 87 | 100 |
| 153 | ZE23-0005 | 110 | 73 | 110 | 89 |
| 154 | ZE23-0007 | 87 | 85 | 97 | 97 |
| 155 | ZE23-0009 | 100 | 98 | 89 | 97 |
| 156 | ZE23-0011 | 110 | 0 * # | 120 | 100 |
| 157 | ZE23-0016 | 140 * | 140 * | 140 * # | 140 * # |
| 158 | ZE23-0018 | 110 | 120 | 130 * | 88 |
| 159 | ZE23-0024 | 110 | 110 | 120 | 130 * |
| 160 | ZE23-0026 | 110 | 53 | 100 | 72 |

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Raw Sewage | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 161 | ZE23-0030 | 130 * | 84 | 110 | 110 |
| 162 | ZE23-0033 | 110 | 88 | 95 | 80 |
| 163 | ZE24-0004 | 97 | 96 | 97 | 87 |
| 164 | ZE24-0012 | 120 | 110 | 120 | 130 * |
| 165 | ZE24-0014 | 120 | 99 | 110 | 120 |
| 166 | ZE24-0016 | 110 | 100 | 110 | 100 |
| 167 | ZE24-0018 | 100 | 82 | 98 | 100 |
| 168 | ZE24-0020 | 94 | 120 | 100 | 76 |
| 169 | ZE24-0022 | 94 | 0 * # | 98 | 68 |
| 170 | ZE25-0001 | 100 | 94 | 98 | 77 |
| 171 | ZE25-0003 | 120 | 96 | 110 | 99 |
| 172 | ZE25-0009 | 100 | 100 | 100 | 99.7 |
| 173 | ZE25-0018 | 74 | 0 * # | 92 | 71 |
| 174 | ZE25-0020 | 100 | 59 | 98 | 100 |
| 175 | ZE25-0022 | 84 | 30 * # | 96 | 102 |
| 176 | ZE26-0001 | 89 | 115 | 102 | 113 |
| 177 | ZE26-0013 | 88 | 35 * # | 75 | 81 |
| 178 | ZE26-0015 | 81 | 76 | 89 | 81 |
| 179 | ZE26-0024 | 119 | 116 | 116 | 117 |
| 180 | ZE27-0002 | 116 | 103 | 118 | 122 * |
| 181 | ZE27-0004 | 98 | 122 * | 103 | 96 |
| 182 | ZE27-0007 | 96 | 41 * # | 99 | 83 |
| 183 | ZE27-0020 | 112 | 39 * # | 105 | 69 |
| 184 | ZE27-0028 | 86 | 70 | 104 | 115 |
| 185 | ZE27-0031 | 124 * | 0 * # | 116 | 119 |
| 186 | ZE27-0034 | 98 * | 149 * # | 103 | 97 |
| 187 | ZE28-0001 | 95 | 97 | 101 | 95 |
| 188 | ZE28-0003 | 97 | 89 | 97 | 93 |
| 189 | ZE28-0007 | 107 | 105 | 102 | 102 |
| 190 | ZE28-0013 | 113 | 90 | 118 | 104 |
| 191 | ZE28-0025 | 148 * # | 108 | 131 * | 120 |
| 192 | ZE28-0027 | 98 | 92 | 102 | 98 |
| 193 | ZE28-0011 | 93 | 92 | 88 | 98 |
| 194 | ZE28-0029 | 97 | 104 | 97 | 96 |
| 195 | ZE28-0016 | 95 | 123 * | 97 | 103 |
| 196 | ZE28-0037 | 70 | 73 | 82 | 54 |
| 197 | ZE28-0039 | 140 * | 84 | 120 | 110 |
| 198 | ZE28-0041 | 71 | 120 | 100 | 110 |
| 199 | ZE29-0009 | 91 | 100 | 94 | 89 |
| 200 | ZE29-0011 | 117 | 121 | 111 | 114 |

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Raw Sewage | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 201 | ZE29-0016 | 117 | 123 | 115 | 115 |
| 202 | ZE29-0018 | 113 | 113 | 110 | 107 |
| 203 | ZE29-0025 | 105 | 111 | 110 | 91 |
| 204 | ZE29-0028 | 128 * | 131 * | 136 * # | 113 |
| 205 | ZE29-0030 | 100 | 112 | 105 | 110 |
| 206 | ZE30-0001 | 83 | 87 | 84 | 91 |
| 207 | ZE30-0003 | 78 | 84 | 75 | 93 |
| 208 | ZE30-0014 | 81 | 79 | 82 | 81 |
| 209 | ZE30-0017 | 83 | 75 | 86 | 86 |
| 210 | ZE30-0020 | 119 | 119 | 107 | 120 |
| 211 | ZE30-0036 | 103 | 107 | 98 | 102 |
| 212 | ZE30-0039 | 99 | 100 | 109 | 102 |
| 213 | ZE31-0005 | 105 | 115 | 108 | 114 |
| 214 | ZE31-0007 | 90 | 103 | 86 | 96 |
| 215 | ZE31-0010 | 109 | 77 | 112 | 108 |
| 216 | ZE31-0038 | 111 | 110 | 114 | 118 |
| 217 | ZE31-0041 | 90 | 86 | 88 | 92 |
| | | | | | |
| Average | | 99.7 | 99.1 | 99.9 | 98.6 |
| S.D. | | 13.8 | 16.3 | 10.4 | 13.5 |

QA/QC Action Limits for Surrogate Recovery: 40-120%
* outside the QA/QC action limits
\# out lier,not include in the calculation

TABLE 2.2.3.1.4

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Sludge | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | ZE05-0017 | 110 | 113 | 114 | 112 |
| 2 | ZE05-0018 | 96.5 | 87.6 | 91.7 | 92.8 |
| 3 | ZE05-0025 | 100 | 98.5 | 100 | 96.3 |
| 4 | ZE05-0026 | 96.5 | 100 | 98.4 | 99 |
| 5 | ZE06-0005 | 126 * | 125 * | 134 * | 130 * |
| 6 | ZE06-0006 | 90.9 | 90.1 | 87 | 88.8 |
| 7 | ZE07-0028 | 103 | 105 | 105 | 106 |
| 8 | ZE07-0029 | 96.1 | 97 | 102 | 94.9 |
| 9 | ZE07-0050 | 140 * # | 121 * | 125 * | 124 * |
| 10 | ZE07-0051 | 103 | 109 | 110 | 111 |
| 11 | ZE07-0054 | 99.9 | 101 | 98.2 | 102 |
| 12 | ZE07-0055 | 105 | 101 | 101 | 103 |
| 13 | ZE07-0061 | 129 * | 123 * | 111 | 111 |
| 14 | ZE07-0062 | 92.4 | 96.9 | 94.3 | 97.3 |
| 15 | ZE08-0007 | 103 | 103 | 102 | 107 |
| 16 | ZE08-0008 | 108 | 107 | 101 | 106 |
| 17 | ZE08-0009 | 99.4 | 101 | 97.8 | 96.8 |
| 18 | ZE09-0008 | 79.3 | 89.1 | 79.3 | 82 |
| 19 | ZE09-0016 | 128 * | 111 | 106 | 108 |
| 20 | ZE09-0017 | 108 | 105 | 104 | 105 |
| 21 | ZE09-0025 | 100 | 97 | 106 | 103 |
| 22 | ZE09-0026 | 125 * | 128 * | 117 | 120 |
| 23 | ZE09-0032 | 97 | 102 | 104 | 101 |
| 24 | ZE09-0033 | 100 | 98.4 | 102 | 101 |
| 25 | ZE10-0007 | 102 | 99.7 | 95 | 101 |
| 26 | ZE10-0008 | 103 | 102 | 103 | 103 |
| 27 | ZE11-0005 | 96.9 | 100 | 91.8 | 74.9 |
| 28 | ZE11-0006 | 108 | 106 | 95.5 | 141 * # |
| 29 | ZE11-0015 | 83.7 | 91.2 | 92.4 | 101 |
| 30 | ZE11-0016 | 89.7 | 90.5 | 89.4 | 76.9 |
| 31 | ZE12-0007 | 106 | 100 | 106 | 99.4 |
| 32 | ZE12-0008 | 107 | 112 | 107 | 110 |
| 33 | ZE12-0017 | 46.1 * # | 88.5 | 94.3 | 127 * |
| 34 | ZE12-0018 | 56.6 * # | 114 | 112.6 | 122 * |
| 35 | ZE13-0013 | 115 | 111 | 102 | 87.4 |
| 36 | ZE13-0008 | 33.6 * # | 28.7 * # | 100 | 105 |
| 37 | ZE13-0022 | 117 | 102 | 101 | 60 # |
| 38 | ZE13-0021 | 107 | 77.9 | 95.5 | 112 |
| 39 | ZE14-0005 | 118 | 32.1 * # | 104 | 80.5 |
| 40 | ZE14-0006 | 57.4 # | 125 * | 116 | 100 |

Table 2.2.3.1.5

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Sludge | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 41 | ZE14-0015 | 58.4 # | 37.6 * # | 146 * # | 116 |
| 42 | ZE14-0016 | 115 | 91.4 | 108 | 93 |
| 43 | ZE15-0005 | 108 | 112 | 102 | 97 |
| 44 | ZE15-0013 | 109 | 127 * | 121 * | 104 |
| 45 | ZE15-0014 | 32.3 * # | 30.7 * # | 101 | 89.3 |
| 46 | ZE18-0017 | 97 | 98 | 95 | 110 |
| 47 | ZE18-0018 | 100 | 100 | 110 | 110 |
| 48 | ZE18-0024 | 98 | 100 | 100 | 110 |
| 49 | ZE18-0025 | 100 | 100 | 110 | 120 |
| 50 | ZE20-0018 | 110 | 100 | 99 | 110 |
| 51 | ZEX21-0009 | 110 | 110 | 120 | 110 |
| 52 | ZEX21-0010 | 110 | 130 * | 110 | 64 # |
| 53 | ZEX21-0015 | 96.0 | 110.0 | 83.0 | 96.0 |
| 54 | ZE22-0014 | 93 | 50 | 94 | 98 |
| 55 | ZEX22-0031 | 130 * | 0 * # | 110 | 0 # |
| 56 | ZEX22-0027 | 120 | 0 * # | 120 | 120 |
| 57 | ZEX22-0015 | 110 | 95 | 130 | 130 * |
| 58 | ZE22-0040 | 99 | 99 | 100 | 75 |
| 59 | ZE22-0045 | 100 | 99 | 110 | 110 |
| 60 | ZE22-0050 | 110 | 130 * | 97 | 110 |
| 61 | ZE22-0051 | 98 | 87 | 100 | 100 |
| 62 | ZE22-0051R | 100 | 100 | 110 | 88 |
| 63 | ZE22-0052 | 100 | 110 | 110 | 110 |
| 64 | ZE23-0022 | 130 * | 130 * | 110 | 110 |
| 65 | ZE23-0023 | 130 * | 150 * # | 110 | 110 |
| 66 | ZE24-0006 | 100 | 120 | 100 | 110 |
| 67 | ZE24-0007 | 49 # | 150 * # | 110 | 120 |
| 68 | ZX25-0005 | 98.4 | 90.8 | 98.1 | 132 * |
| 69 | ZX25-0006 | 100 | 56.4 | 100.3 | 100.7 |
| 70 | ZX25-0013 | 102.3 | 62.7 | 97.7 | 99.3 |
| 71 | ZX25-0014 | 109.3 | 50.2 | 99.7 | 99.7 |
| 72 | ZE26-0005 | 178 * # | INT | 124 * | 149 * # |
| 73 | ZE26-0006 | 112 | 104 | 110 | 122 * |
| 74 | ZE27-0007 | 96 | 41 # | 99 | 83 |
| 75 | ZE27-0016 | 85 | 47 # | 87 | 76 |
| 76 | ZE27-0017 | 83 | 50 | 85 | 152 * # |
| 77 | ZE28-0017 | 118 | 126 * | 112 | 117 |
| 78 | ZE28-0020 | 126 * | 225 * # | 129 * | 163 * # |
| 79 | ZE28-0008 | 105 | 86 | 101 | 100 |
| 80 | ZE29-0007 | 98 | 92 | 95 | 91 |

Table 2.2.3.1.5

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Sludge | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 91 | ZE29-0008 | 113 | 73 | 98 | 94 |
| 92 | ZE29-0013 | 109 | 87 | 98 | 90 |
| 93 | ZE29-0020 | 81 | 68 | 95 | 84 |
| 94 | ZE30-0007 | 129 * | 133 * | 128 * | 127 * |
| 85 | ZE30-0007R | 73 | 76 | 86 | 81 |
| 86 | ZE30-0008 | 107 | 97 | 97 | 106 |
| 87 | ZE31-0016 | 118 | 89 | 121 * | 116 |
| 88 | ZE31-0017 | 103 | 95 | 95 | 99 |
| 89 | ZE31-0032 | 107 | 99 | 104 | 108 |
| 90 | ZE31-0033 | 100 | 118 | 102 | 102 |
| 91 | ZE31-0044 | 81 | 85 | 83 | 86 |
| 92 | ZE31-0045 | 93 | 108 | 94 | 104 |
| 93 | ZE31-0046 | 94 | 84 | 91 | 91 |
| 94 | ZE31-0046R | 105 | 135 * | 101 | 104 |
| | | | | | |
| Average | | 104.0 | 100.4 | 102.9 | 102.9 |
| S.D. | | 12.2 | 17.6 | 10.5 | 12.9 |

QA/QC Action Limits for Surrogate Recovery 40-120%
* ouside the QA /QC action limits
# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.1.5

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Method Blank | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 d6- Benzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | Jan.28,87' | 141 * | 117 | 135 * | 125 * |
| 2 | Jan.28,87' | 117 | 95.6 | 98.2 | 96.7 |
| 3 | Feb.5,87' | 103 | 102 | 98.6 | 102 |
| 4 | Feb.6,87' | 125 * | 114 | 114 | 115 |
| 5 | Feb.12,87' | 94 | 95.3 | 87.5 | 91.7 |
| 6 | Feb.17,87 | 116 | 107 | 107 | 108 |
| 7 | Feb.23,87 | 92.6 | 89 | 93.2 | 91 |
| 8 | Feb.24,87' | 91.9 | 98.8 | 117 | 113 |
| 9 | Feb.25,87' | 102 | 87.7 | 115 | 96.6 |
| 10 | Feb.26,87' | 123 * | 102 | 120 | 108 |
| 11 | Feb.27,87' | 95.9 | 83.3 | 110 | 95.5 |
| 12 | Feb.28,87' | 89.4 | 77.4 | 101 | 85 |
| 13 | Mar.2,87' | 93.2 | 79.9 | 86 | 85.1 |
| 14 | Mar.5,87' | 75.1 | 70.9 | 71 | 74.1 |
| 15 | Mar.6,87' | 80.3 | 81 | 92.3 | 89.2 |
| 16 | Mar.6,87' | 121 * | 38.2 * | 121 * | 98.6 |
| 17 | Mar.8,87' | 110 | 100 | 100 | 90 |
| 18 | Mar.9,87' | 120 | 120 | 150 * # | 110 |
| 19 | Mar.12,87' | 84.6 | 83.3 | 76.8 | 78.6 |
| 20 | Mar.10,87' | 87.7 | 93 | 99.9 | 98.1 |
| 21 | Mar.20,87' | 110 | 110 | 100 | 99 |
| 22 | Mar.23,87' | 110 | 120 | 110 | 120 |
| 23 | Mar.24,87' | 110 | 110 | 150 * # | 110 |
| 24 | Mar.26,87' | 120 | 84 | 140 * | 110 |
| 25 | Mar.27,87' | 100 | 130 * | 110 | 160 |
| 26 | Mar.31,87' | 57 * | 43 * | 61 | 49 * |
| 27 | Apr.3,87' | 100 | 100 | 100 | 91 |
| 28 | Apr.10,87' | 118 | 158 * | 97.2 | 87.3 |
| 29 | Apr.14,87' | 84.5 | 96.2 | 79.9 | 83.2 |
| 30 | Apr.15,87' | 101 | 101 | 91.6 | 93.1 |
| 31 | May 1,87' | 110 | 120 | 110 | 110 |
| 32 | May 2,87' | 98 | 110 | 100 | 110 |
| 33 | May 4,87' | 98 | 98 | 100 | 96 |
| 34 | May 6,87' | 100 | 100 | 93 | 100 |
| 35 | May 10,87' | 100 | 100 | 99 | 89 |
| 36 | May 13,87' | 96 | 110 | 82 | 92 |
| 37 | May 17,87' | 120 | 150 * | 120 | 120 |
| 38 | May 21,87' | 100 | 100 | 98 | 110 |
| 39 | May 25,87' | 110 | 110 | 150*# | 110 |
| 40 | June 3,87' | 93 | 82 | 110 | 78 |
| 41 | June 4,87' | 99 | 120 | 89 | 98 |
| 42 | June 5,87' | 50 * # | 45 * | 40 * # | 40 * # |

Table 2.2.3.1.6

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Method Blank | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 d6- Benzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 43 | June 9,87' | 110 | 150 * | 100 | 160 * # |
| 44 | June 11,87' | 45 *# | 41 * | 61 | 50 * |
| 45 | June 12,87' | 120 | 150 * | 87 | 72 |
| 46 | June 13,87' | 130 * | 100 | 120 | 110 |
| 47 | June 14,87' | 110 | 130 * | 100 | 100 |
| 48 | June 15,87' | 53 * # | 19 * | 59 * | 49 * |
| 49 | June 16,87' | 110 | 0 * # | 94 | 88 |
| 50 | June 23,87' | 97 | 110 | 77 | 100 |
| 51 | June 24,87' | 69 | 0 * # | 86 | 76 |
| 52 | June 25,87' | 54 * # | 0 * # | 52.2 *# | 37.9 * # |
| 53 | July 7,87' | 74 | 0 * # | 89 | 79 |
| 54 | July 9,87' | 88 | 0 * # | 85 | 78 |
| 55 | July 13,87' | 87 | 0 * # | 90 | 61 |
| 56 | July 14,87' | 113 | 0 * # | 119 | 55 * |
| 57 | July 17,87' | 104 | 0 * # | 97 | 88 |
| 58 | July 21,87' | 98 | 0 * | 91 | 124 * |
| 59 | July 21,87' | 105 | 115 | 107 | 102 |
| 60 | July 23,87' | 105 | 90 | 107 | 104 |
| 61 | July 24,87' | 93 | 110 | 110 | 100 |
| 62 | July 27,87' | 190 *# | 180 *# | 150 *# | 140 * |
| 63 | July 28,87' | 110 | 27 * | 98 | 94 |
| 64 | July 29,87' | 117 | 27 * | 92 | 84 |
| 65 | Aug.4,87' | 100 | 122 * | 113 | 108 |
| 66 | Aug.6,87' | 57 *# | 57 * | 64 | 57 * |
| 67 | Aug.10,87' | 54 *# | 49 * | 44*# | 38*# |
| 68 | Aug.11,87' | 96 | 77 | 104 | 97 |
| 69 | Aug.12,87' | 59 *# | 70 | 82 | 77 |
| 70 | Aug.14,87' | 86 | 95 | 91 | 90 |
| 71 | Aug.17,87' | 107 | 100 | 109 | 97 |
| 72 | Aug.18,87' | 105 | 114 | 110 | 101 |
| 73 | Aug.19,87' | 104 | 105 | 98 | 103 |
| | | | | | |
| Average | | 102.1 | 96.1 | 98.1 | 94.9 |
| SD | | 14.1 | 30.7 | 16.3 | 19.8 |
| | | | | | |

QA/QC Action Limits for Surrogate Recovery are: 60-120%
* outside the QA/QC limits

Table 2.2.3.1.6

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND - SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.-Aug./87 |
| Matrix Type | Water Spike | | |

| No | Zenon Sample I.D. | Surrogate #1 d4-Dichloroethane % REC. | Surrogate #2 Bromofluorobenzene %REC. | Surrogate #3 d8-Toluene %REC. | Surrogate #4 d5-Chlorobenzene %REC. |
|---|---|---|---|---|---|
| 1 | Feb. 17 | 107.2 | 110 | 110.8 | 107.6 |
| 2 | Feb. 25 | 110.3 | 111.3 | 102.4 | 107.3 |
| 3 | Feb. 26 | 99.1 | 98.3 | 96.8 | 98.3 |
| 4 | Feb. 27 | 102.3 | 108.5 | 98.2 | 104 |
| 5 | Feb. 28 | 106 | 111.4 | 100.3 | 114.3 |
| 6 | Mar. 2 | 99.4 | 104.6 | 94.7 | 100.2 |
| 7 | Mar. 5 | 112 | 117.5 | 106.2 | 115.8 |
| 8 | Mar. 9 | 92 | 91.2 | 91.5 | 89.9 |
| 9 | Mar. 10 | 97.8 | 96.3 | 100.7 | 88.8 |
| 10 | Mar. 18 | 91.6 | 91.9 | 84.5 | 92.9 |
| 11 | Mar. 24 | 66.7 # | 101.1 | 97.7 | 96.8 |
| 12 | Apr. 15 | 60.9 # | 61 # | 99.5 | 81.1 |
| 13 | May 11 | 100.3 | 99.6 | 98.5 | 99.1 |
| 14 | May 12 | 106.6 | 102.8 | 99.9 | 96.2 |
| 15 | May 18 | 98.9 | 100.9 | 95.9 | 94.4 |
| 16 | May 19 | 101.2 | 135.8 * | 111.6 | 123.8 * |
| 17 | May 25 | 99.6 | 94.2 | 102 | 96 |
| 18 | June 02 | 77.4 | 84.2 | 80.2 # | 85.2 |
| 19 | June 10 | 101.9 | 100 | 98.8 | 100 |
| 20 | June 17 | 100.3 | 85 | 100 | 101.9 |
| 21 | June 25 | 106.5 | 45.1 # | 99.9 | 66 # |
| 22 | June 26 | 91.7 | 88.5 | 93.7 | 96.3 |
| 23 | July 16 | 75 | 30.4 # | 105.6 | 73.2 |
| 24 | July 27 | 111.9 | 112.7 | 117.1 # | 114.3 |
| 25 | Aug. 4 | 101 | 107.6 | 102.6 | 104.2 |
| 26 | Aug. 10 | 73.6 | 68.3 | 61.3 # | 78.5 |
| 27 | Aug. 14 | 98.3 | 108.2 | 83.2 # | 123.1 * |
| 28 | Aug. 17 | 111.4 | 101.2 | 104 | 106.6 |
| | | | | | |
| Average | | 99 | 101 | 98 | 100 |
| SD | | 10 | 13 | 11 | 13 |

QA/QC Action Limits for Surrogate Recove 60-120%
* ouside the QA/QC action limits
# outlier, not included in the calculation of average and standard deviation

Table 2.2.3.1.7

# VOA SURROGATE d4-DICHLOROETHANE RECOVERY
## (Primary Final Effluent)

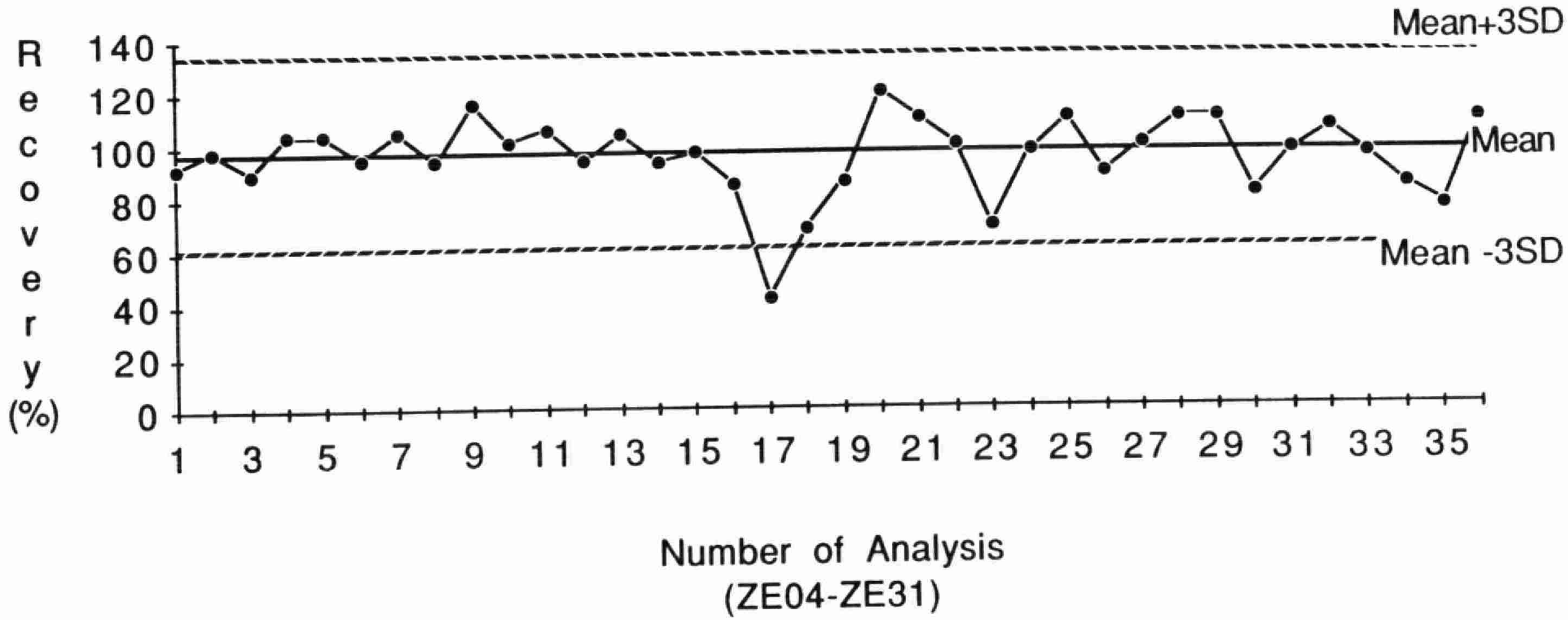


Fig. 2.2.3.1.1

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Primary Final Effluent)

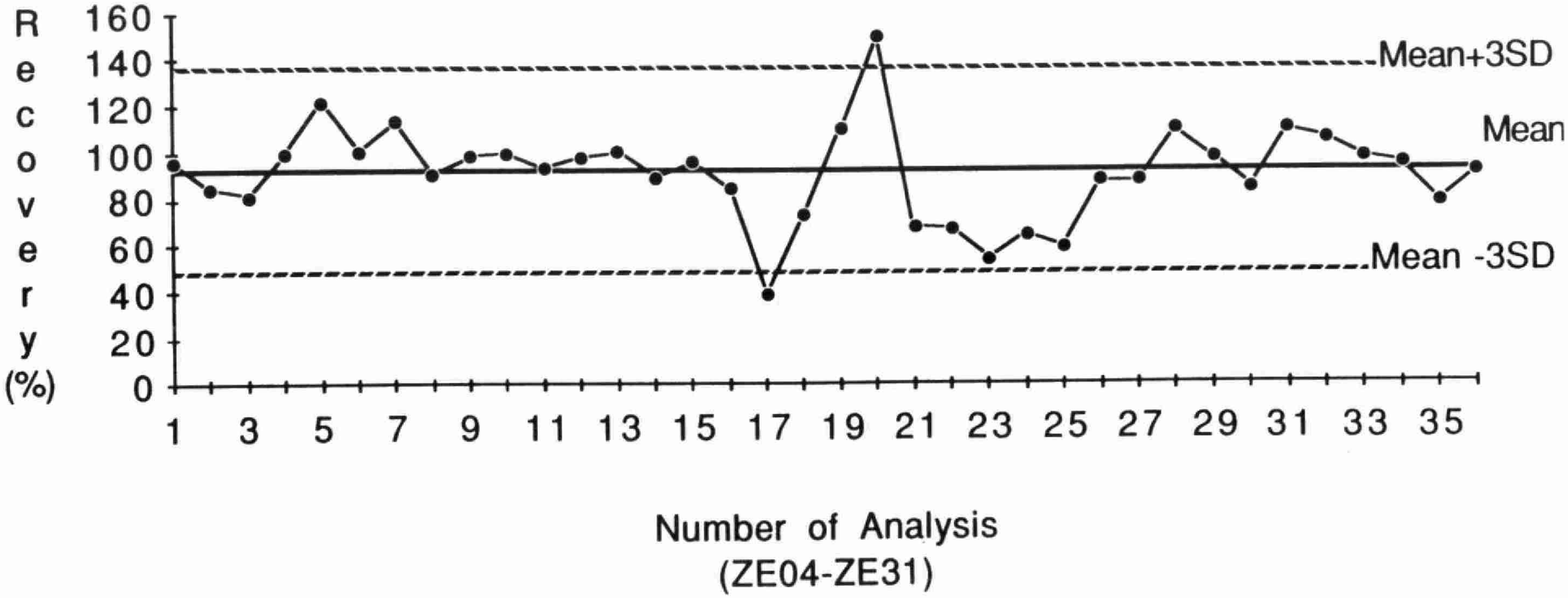


Fig. 2.2.3.1.2

## VOA SURROGATE d8-TOLUENE RECOVERY
## (Primary Final Effluent)

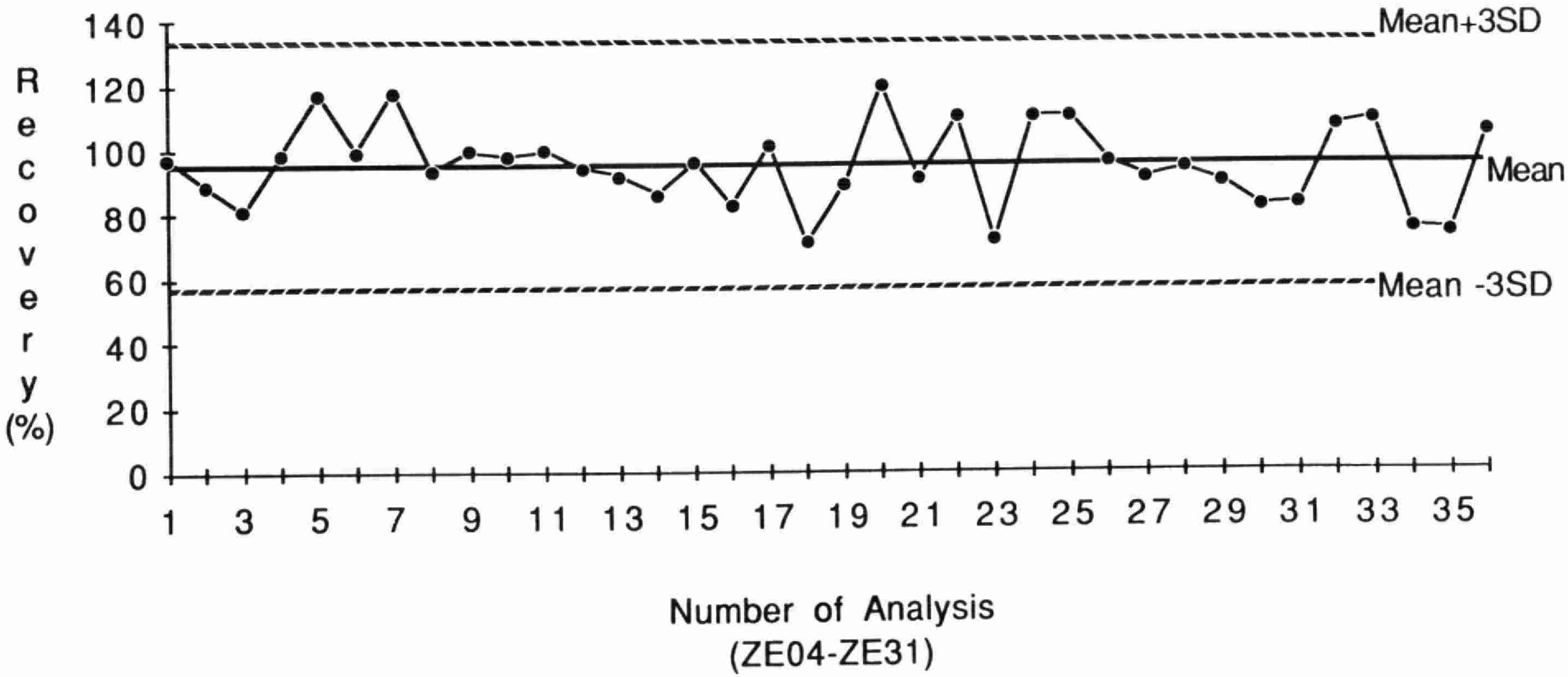


Fig. 2.2.3.1.3

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
## (Primary Final Effluent)

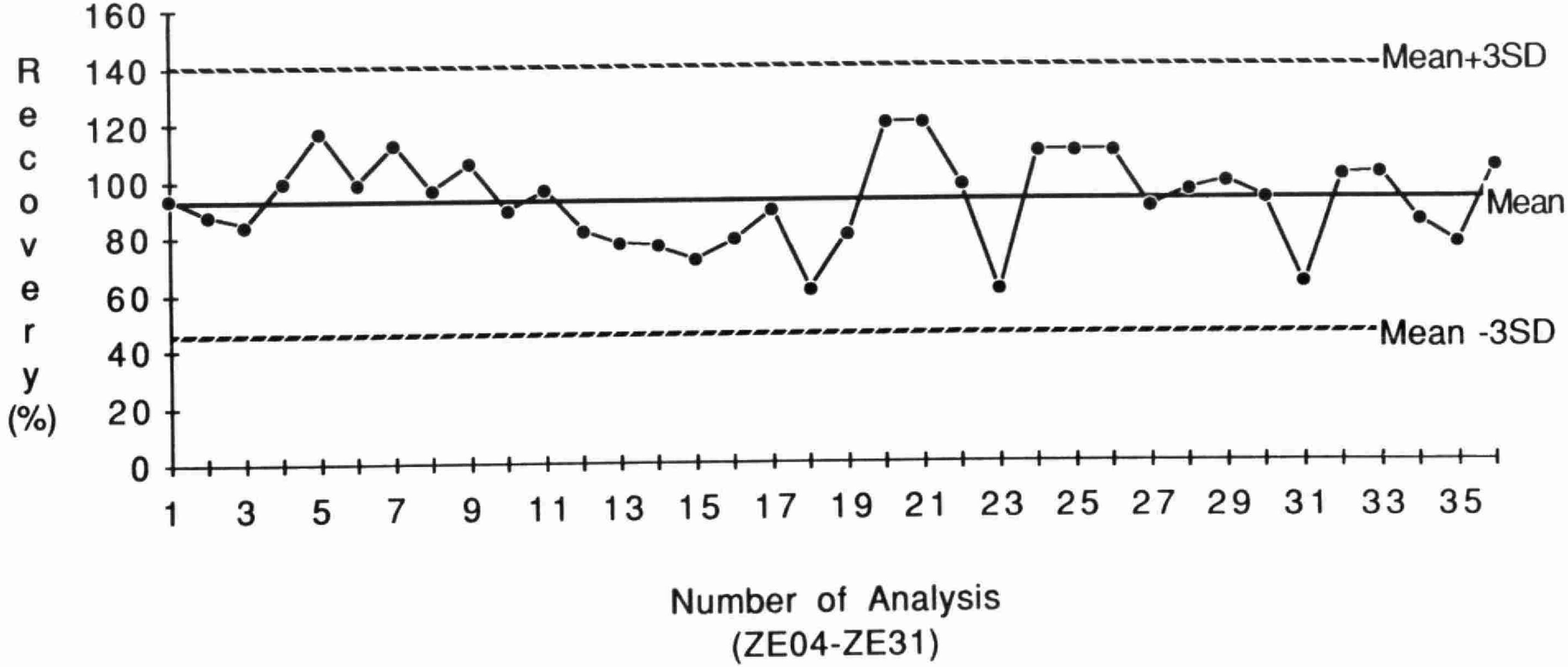


Fig. 2.2.3.1.4

## VOA SURROGATE d4-DICHLOROETHANE RECOVERY
(Secondary Final Effluent )

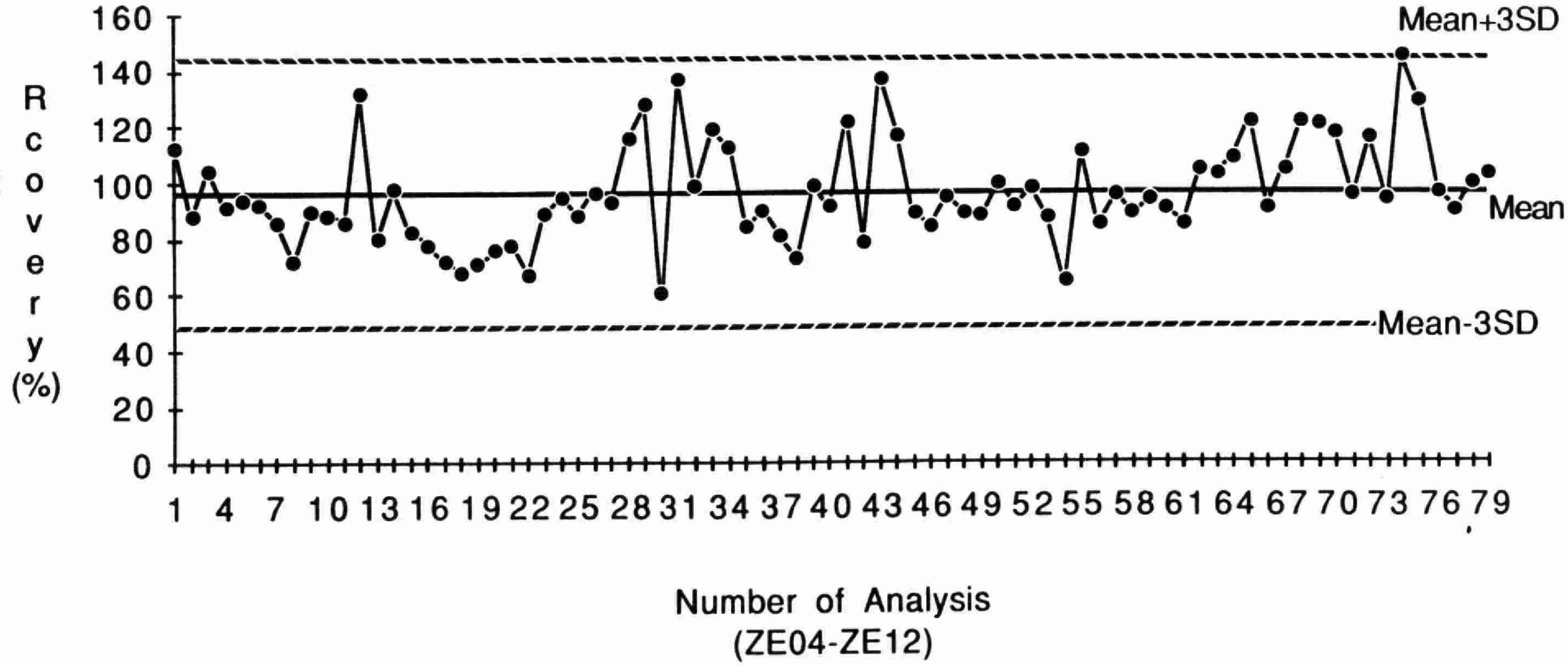




Fig. 2.2.3.1.**5**

# VOA SURROGATE d4-DICHLOROETHANE RECOVERY
(Secondary Final Effluent)

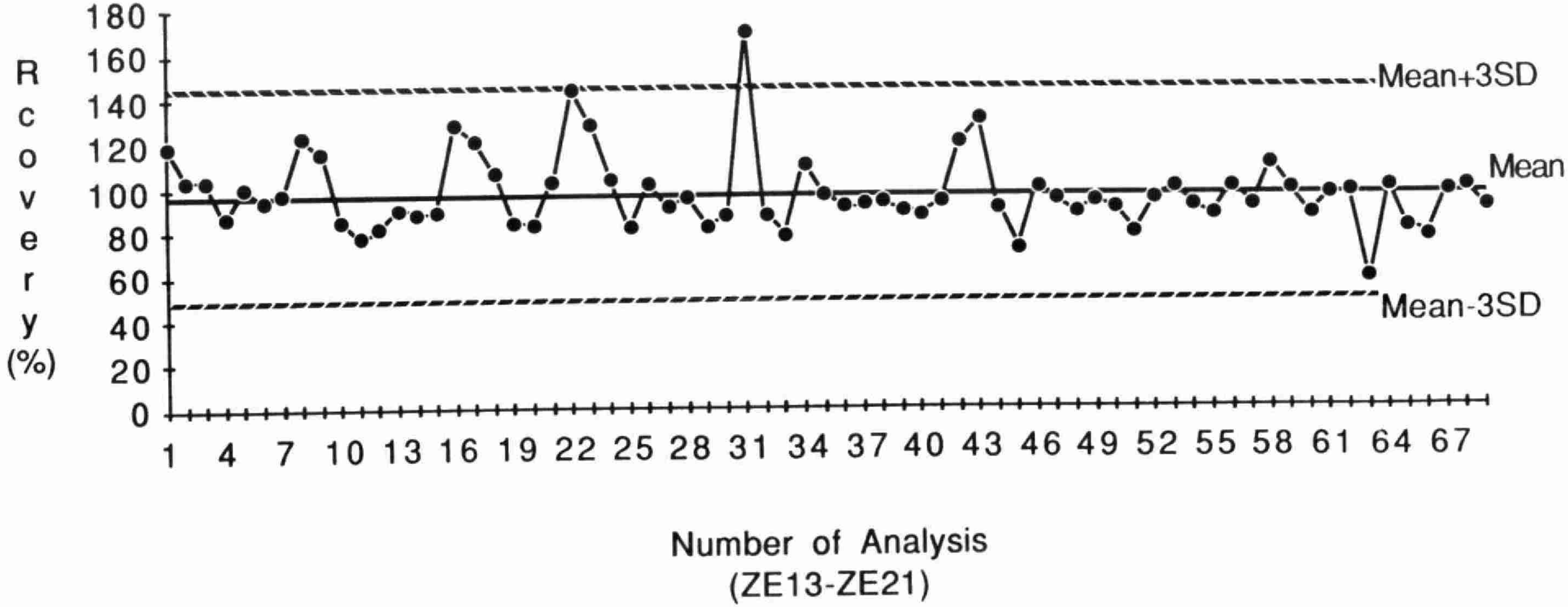


Fig. 2.2.3.1.5a

## VOA SURROGATE d4-DICHLOROETHANE RECOVERY
(Secondary Final Effluent)

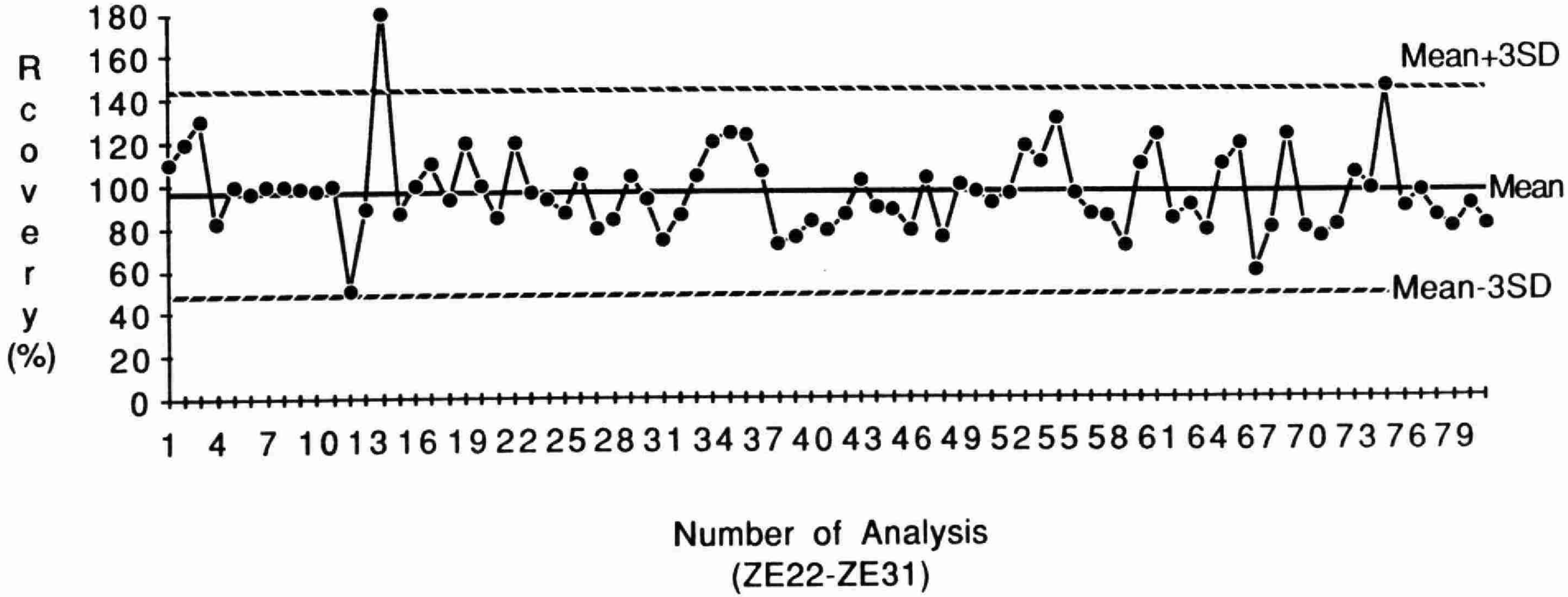


Fig. 2.2.3.1.5b

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Secondary Final Effluent )



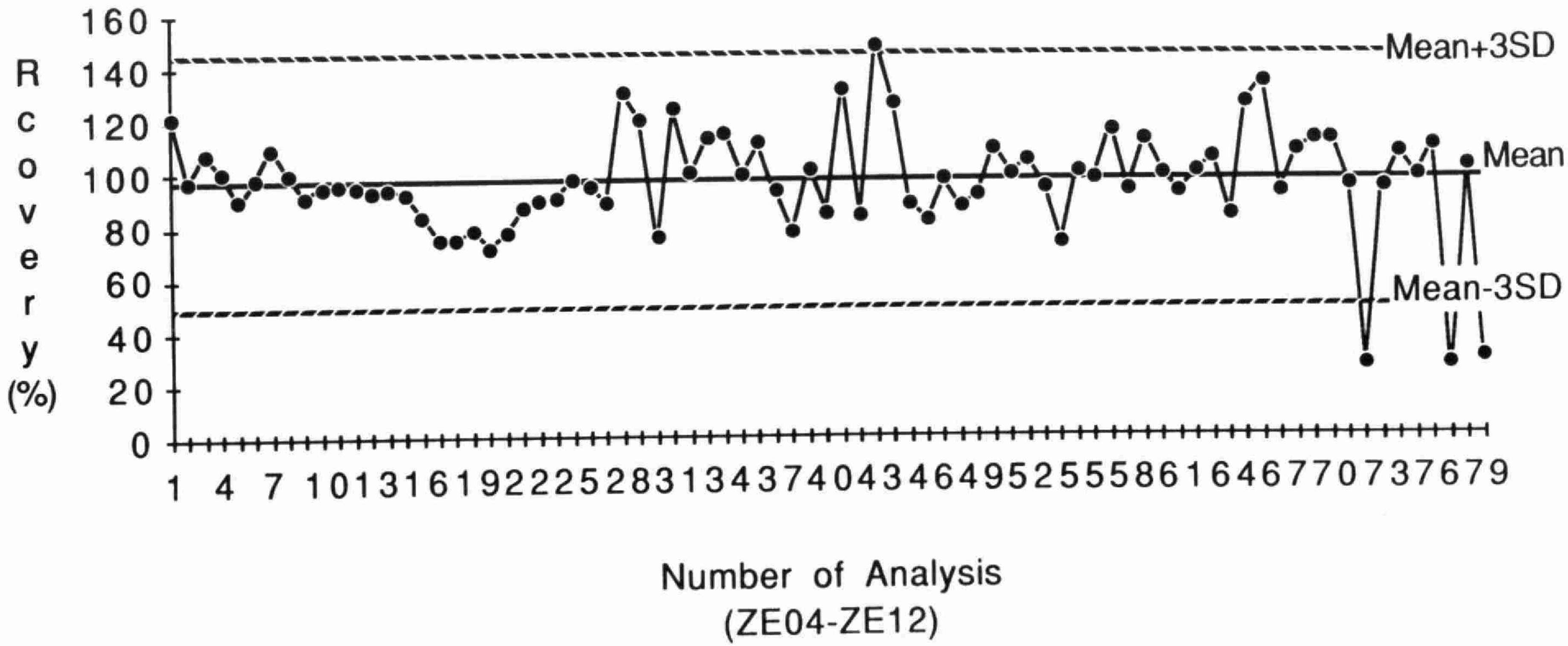


Fig. 2.2.3.1.6

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
(Secondary Final Effluent)

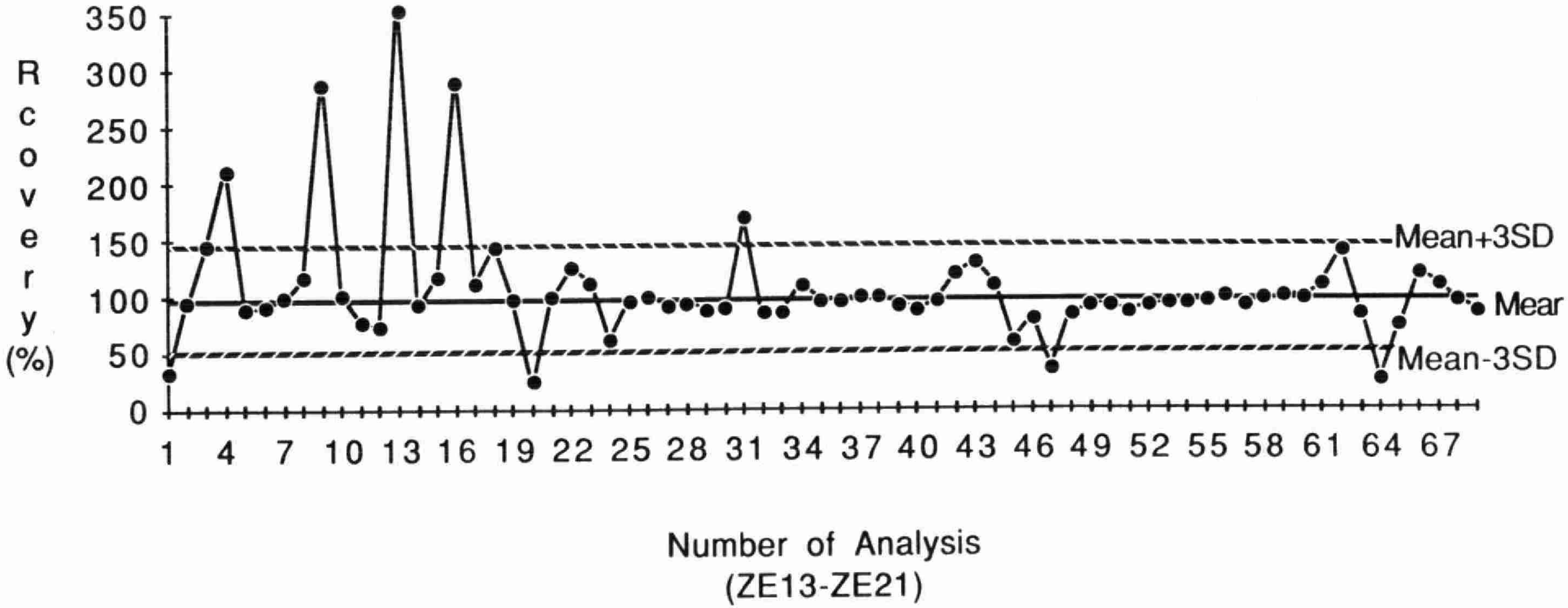


Fig. 2.2.3.1.6a

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Secondary Final Effluent)

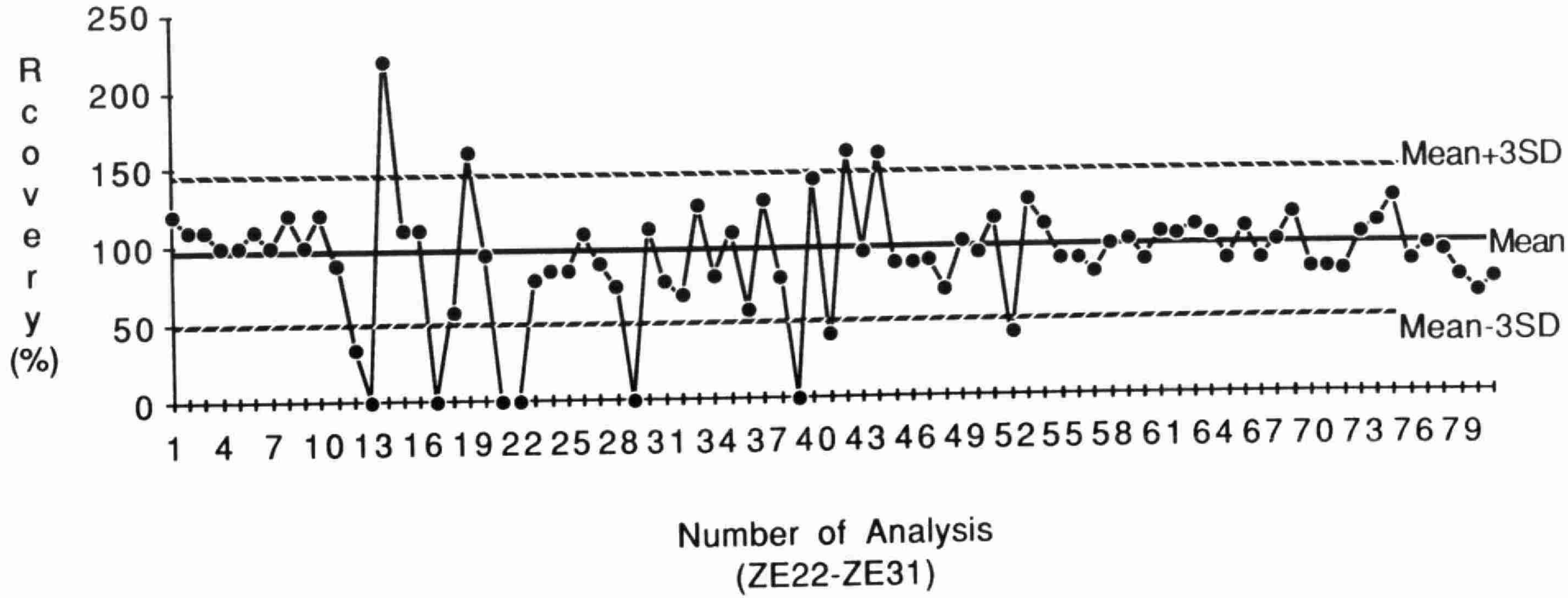


Fig. 2.2.3.1.6b

**VOA SURROGATE d8-TOLUENE RECOVERY**
**(Secondary Final Effluent )**

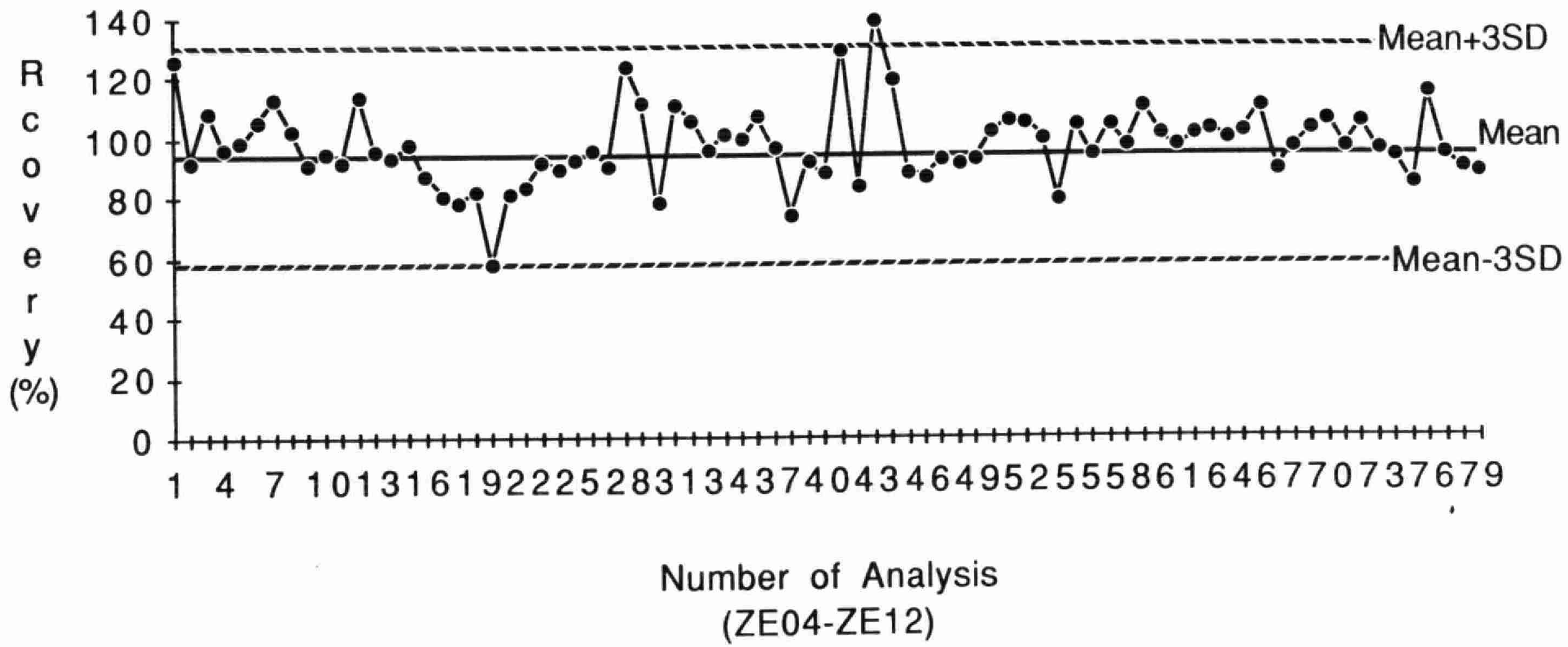


Fig. 2.2.3.1.7

VOA SURROGATE d8-TOLUENE RECOVERY
(Secondary Final Effluent)

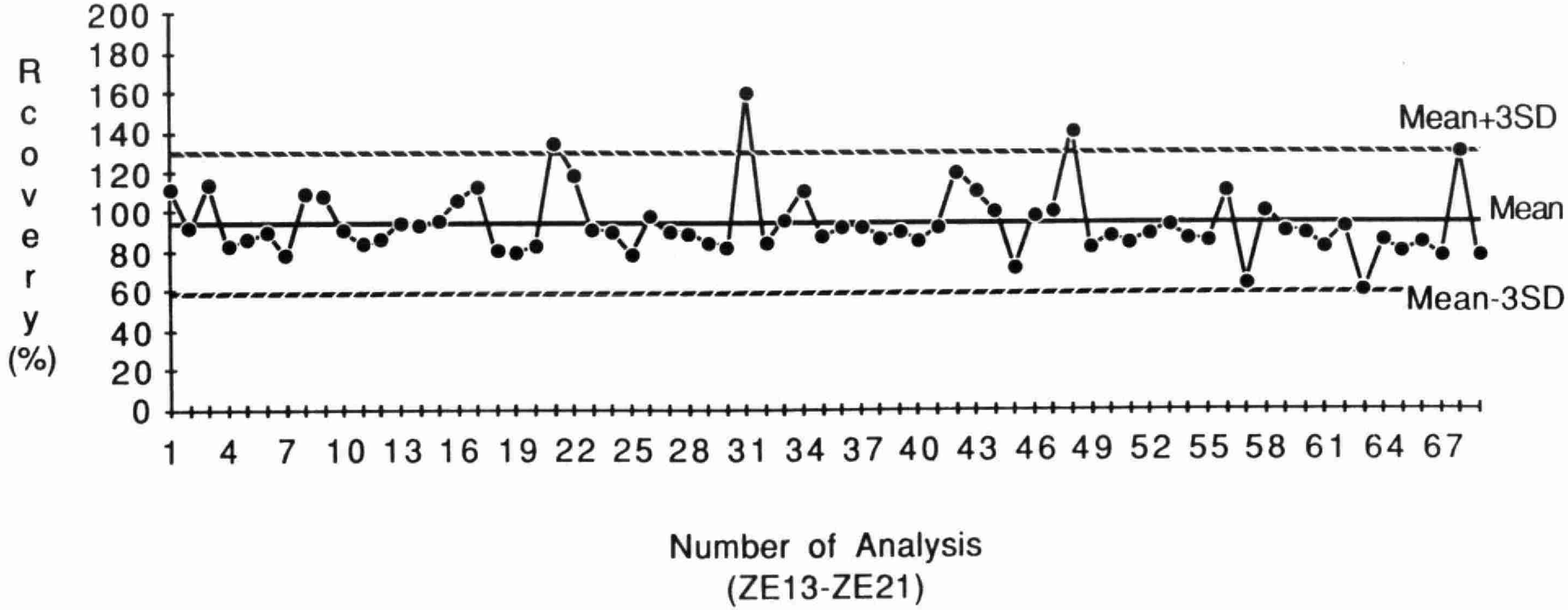


Fig. 2.2.3.1.7a

# VOA SURROGATE d8-TOLUENE RECOVERY
## (Secondary Final Effluent)

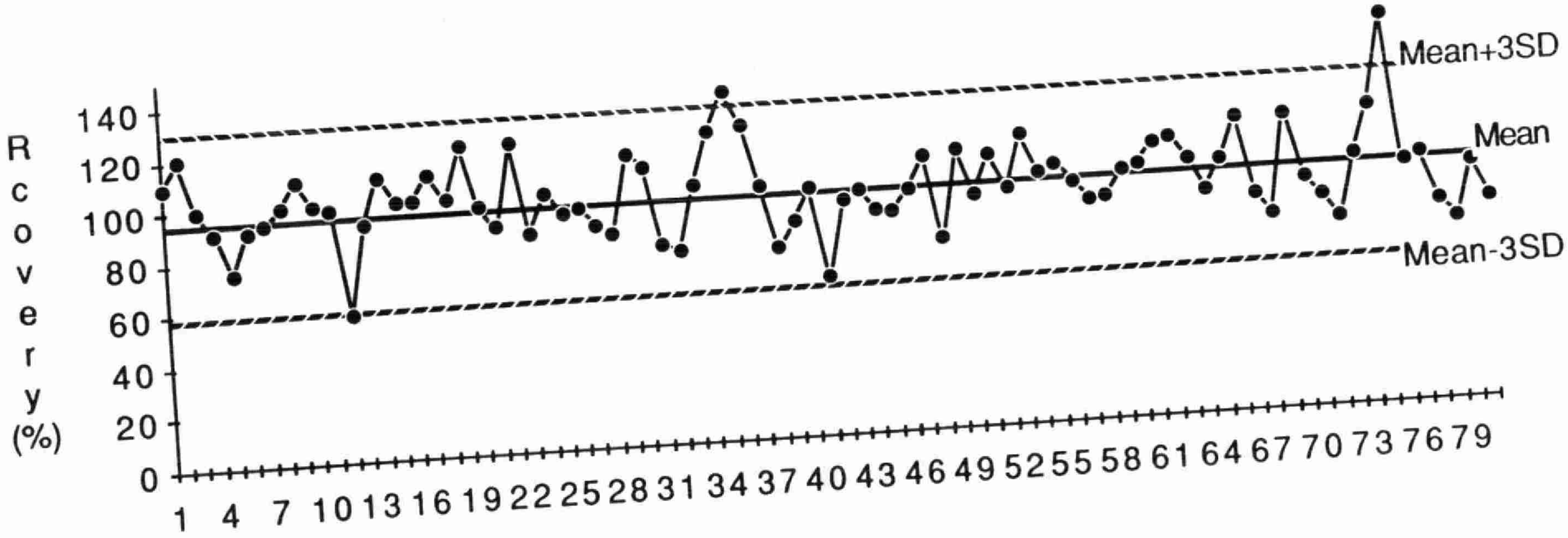




Fig. 2.2.3.17b

# VOA SURROGATE d5-CHLOROBENZENE RECOVERY
## (Secondary Final Effluent)

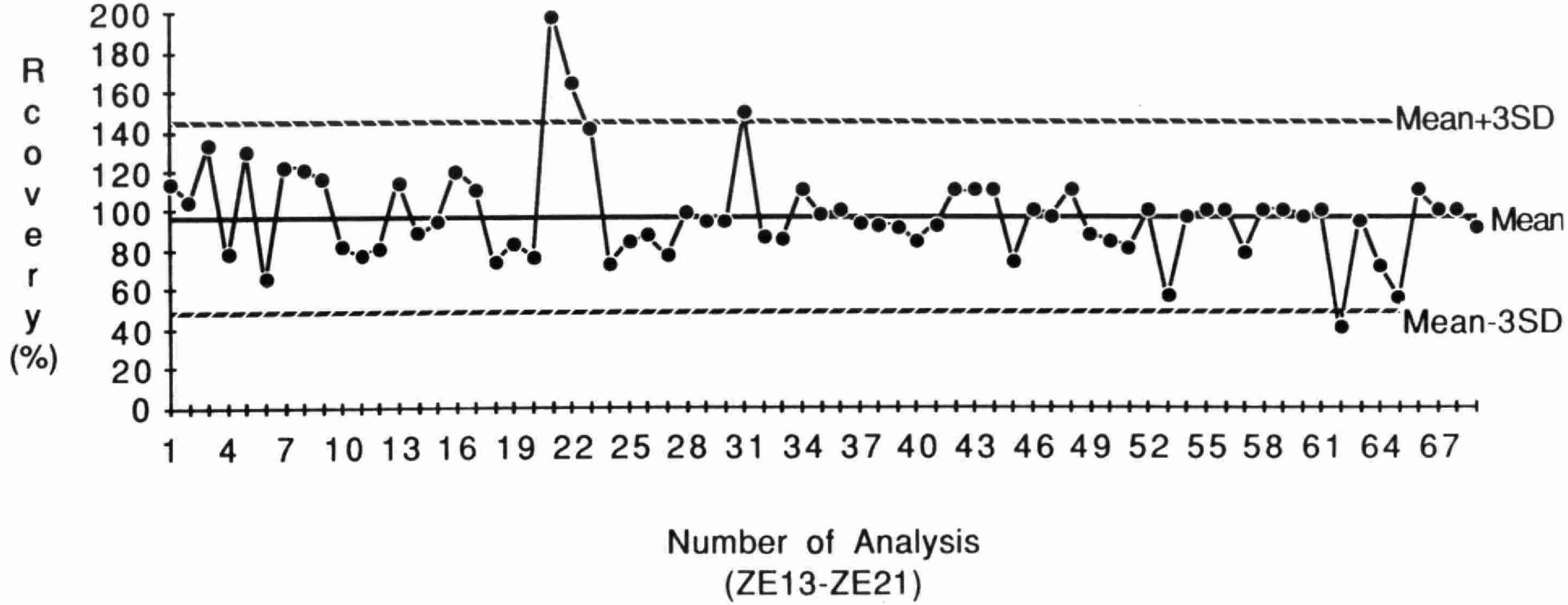


Fig. 2.2.3.1.8a

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Secondary Final Effluent)

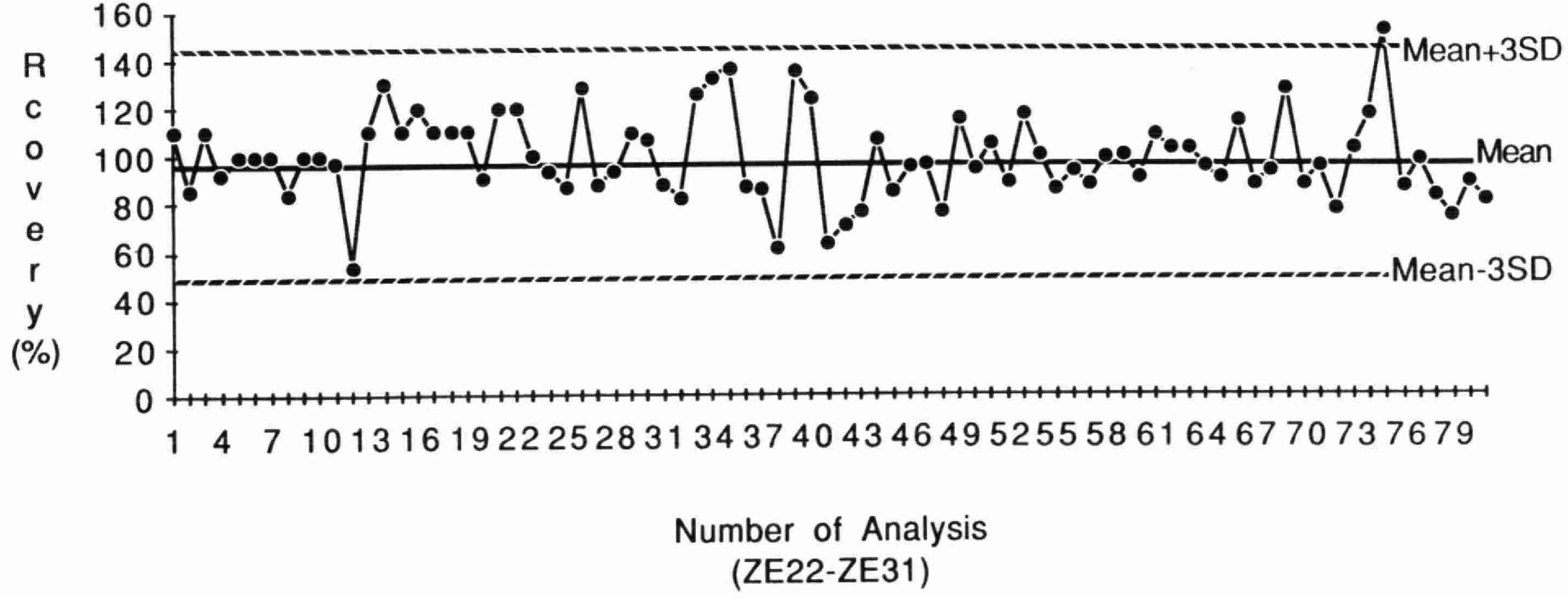


Fig. 2.2.3.1.8b

# VOA SURROGATE d4-DICHLOROETHANE RECOVERY
## (Return Recycle)

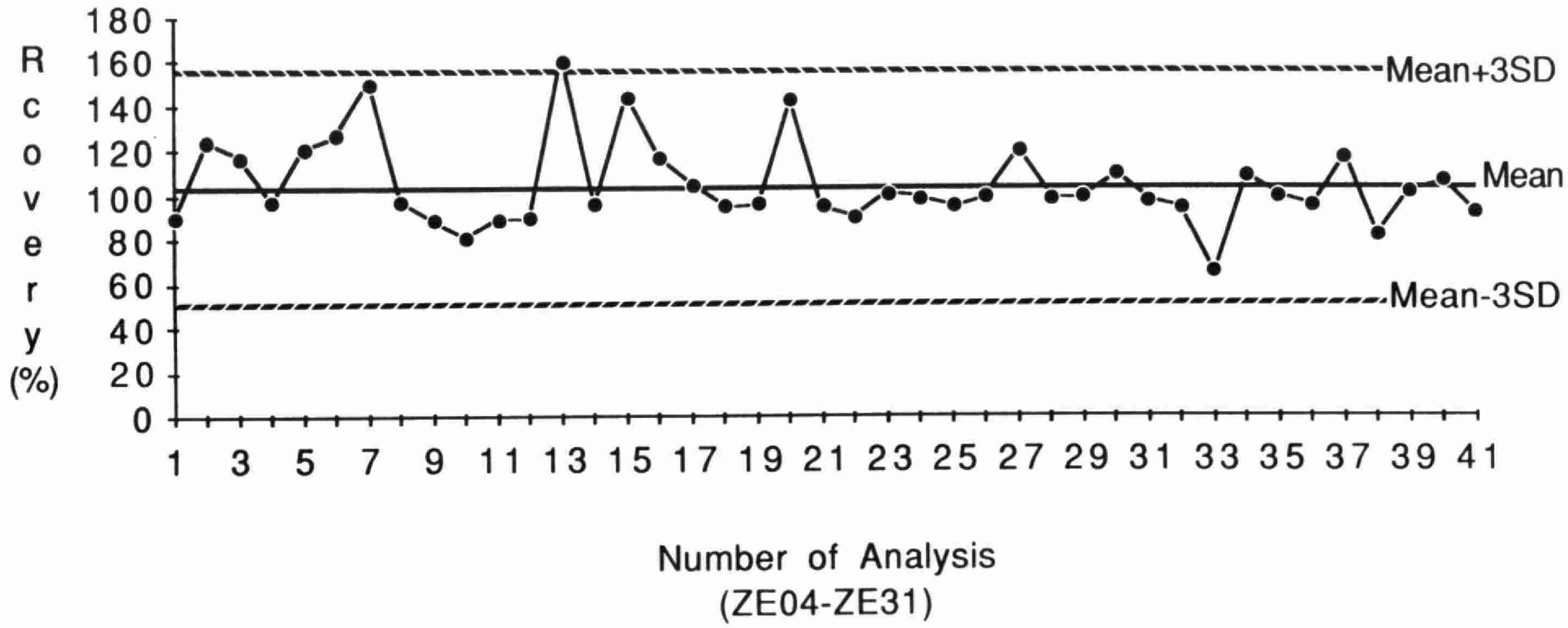


Fig. 2.2.3.1.9

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Return Recycle)

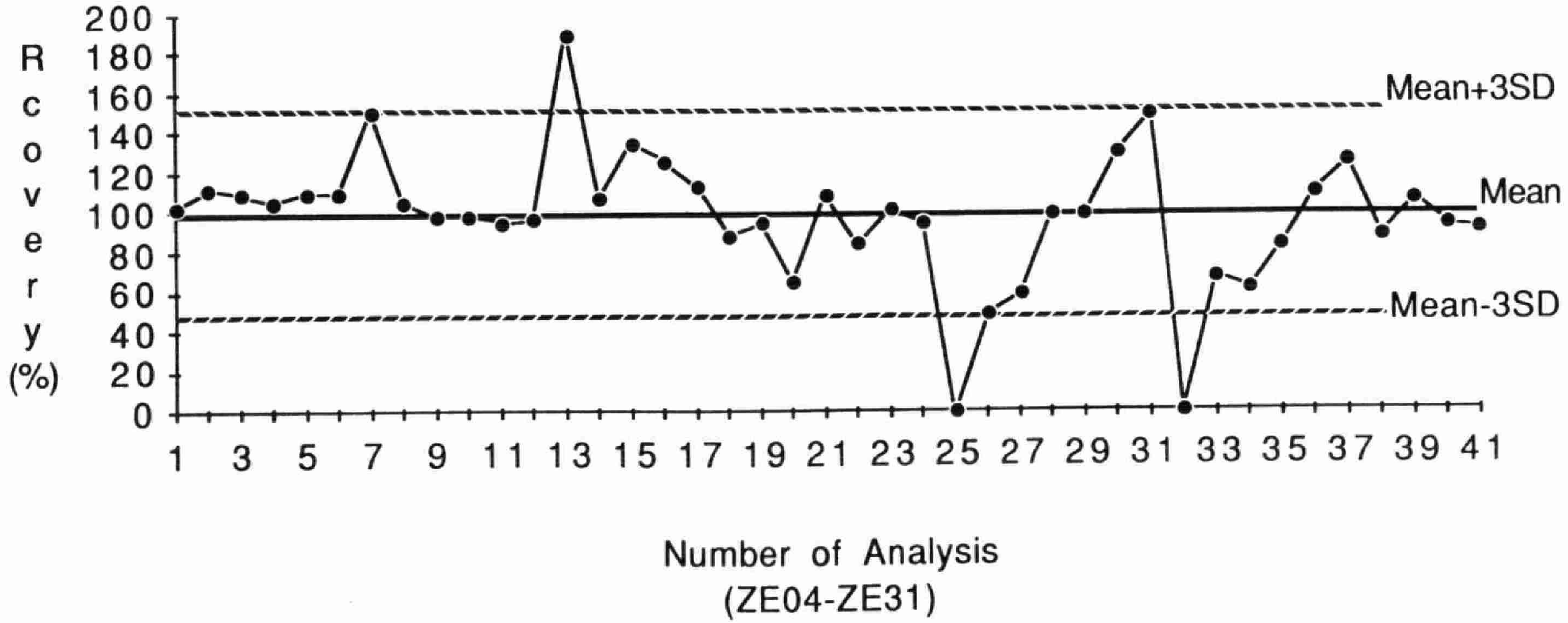


Fig. 2.2.3.1.10

# VOA SURROGATE d8-TOLUENE RECOVERY
## (Return Recycle)

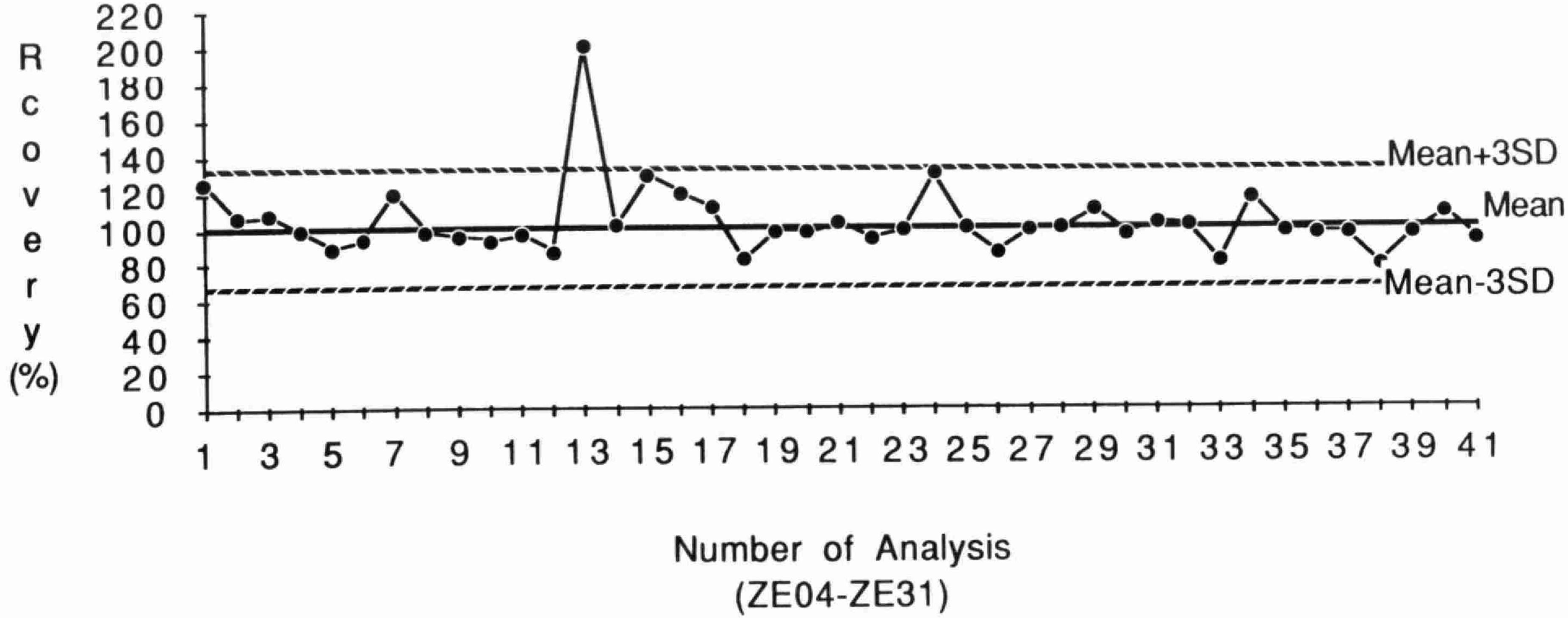


Fig. 2.2.3.1.11

**VOA SURROGATE d5-CHLOROBENZENE RECOVERY**
**(Return Recycle)**

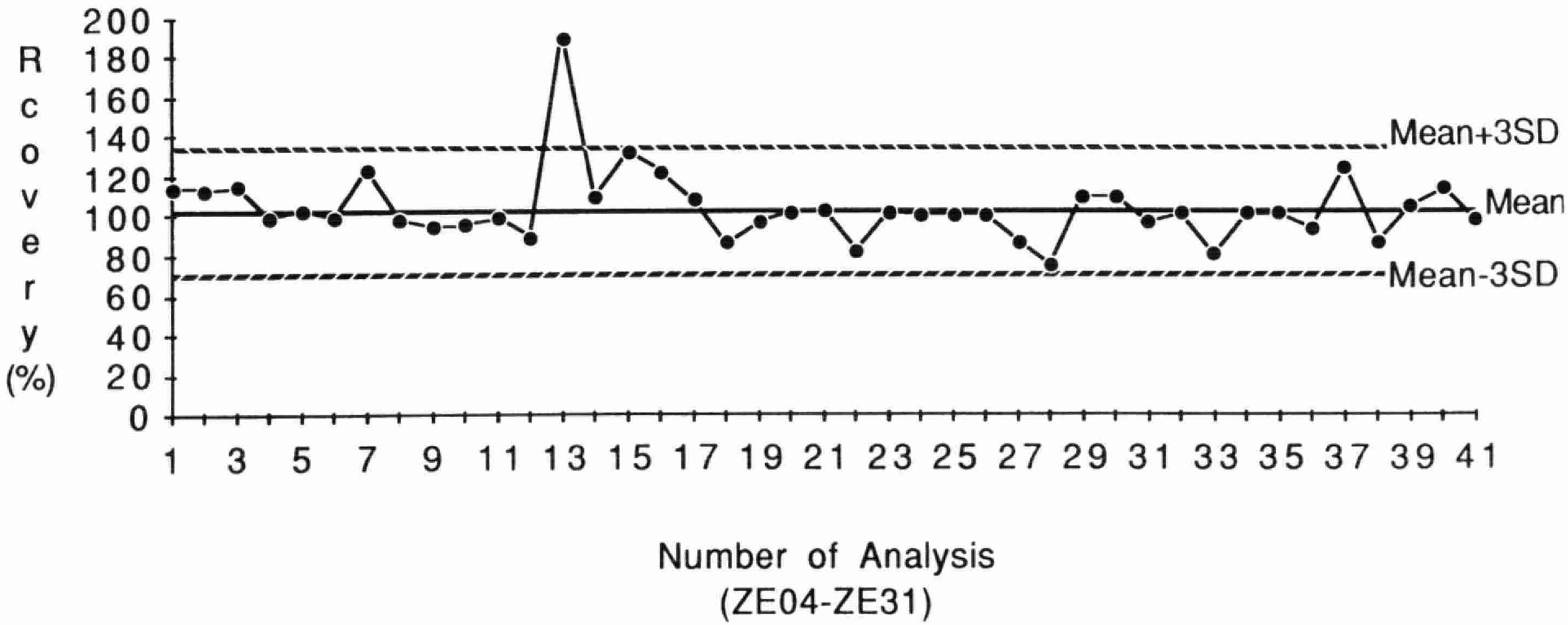


Fig. 2.2.3.1.12

## VOASURROGATE d4-DICHLOROETHANE RECOVERY
(Raw Sewage)

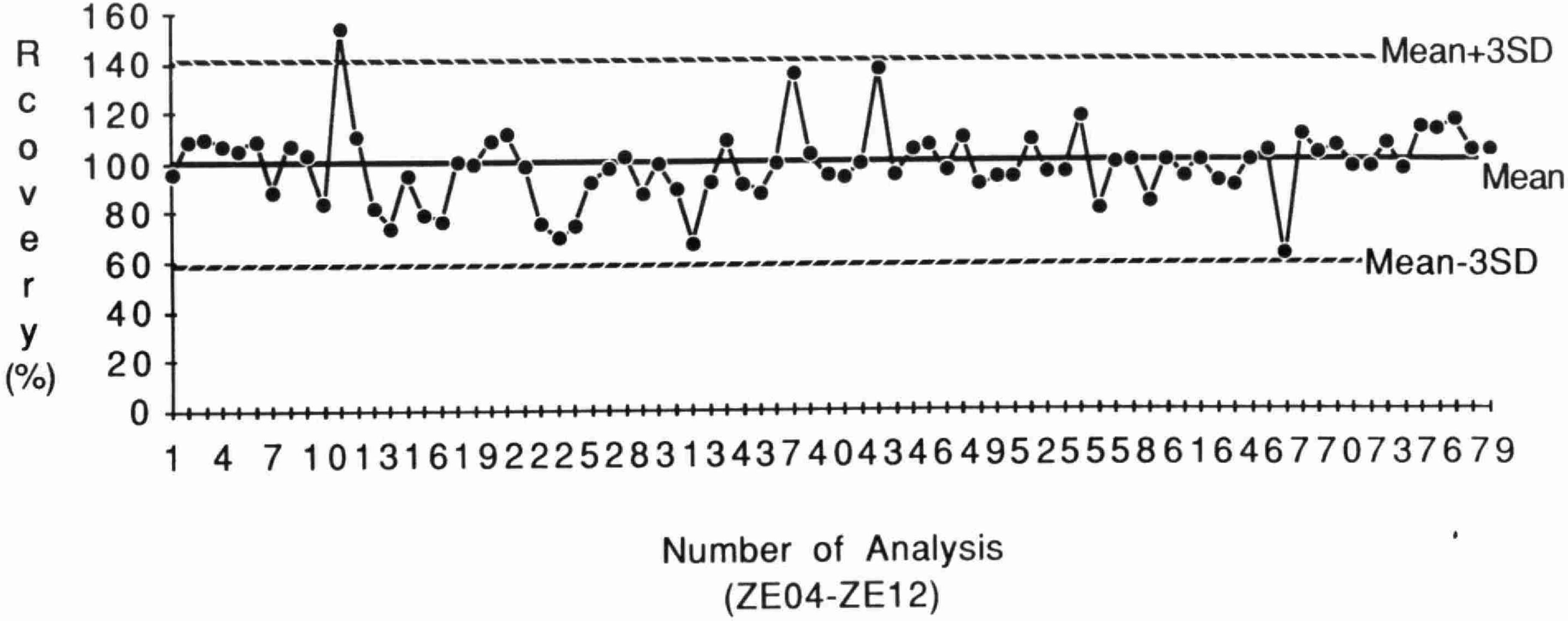


Fig. 2.2.3.1.13

# VOA SURROGATE d4-DICHLOROETHANE RECOVERY
(Raw Sewage)

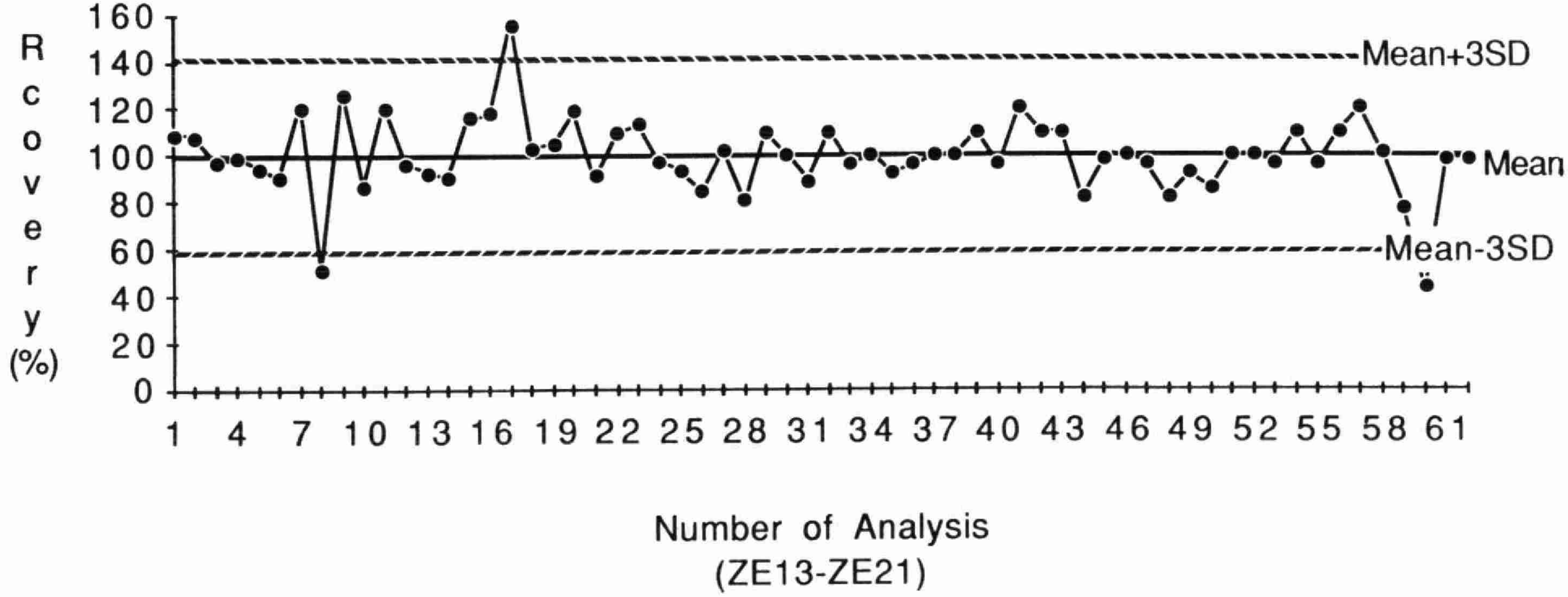


Fig. 2.2.3.1.13a

# VOA SURROGATE d4-DICHLOROETHANE RECOVERY
(Raw Sewage)

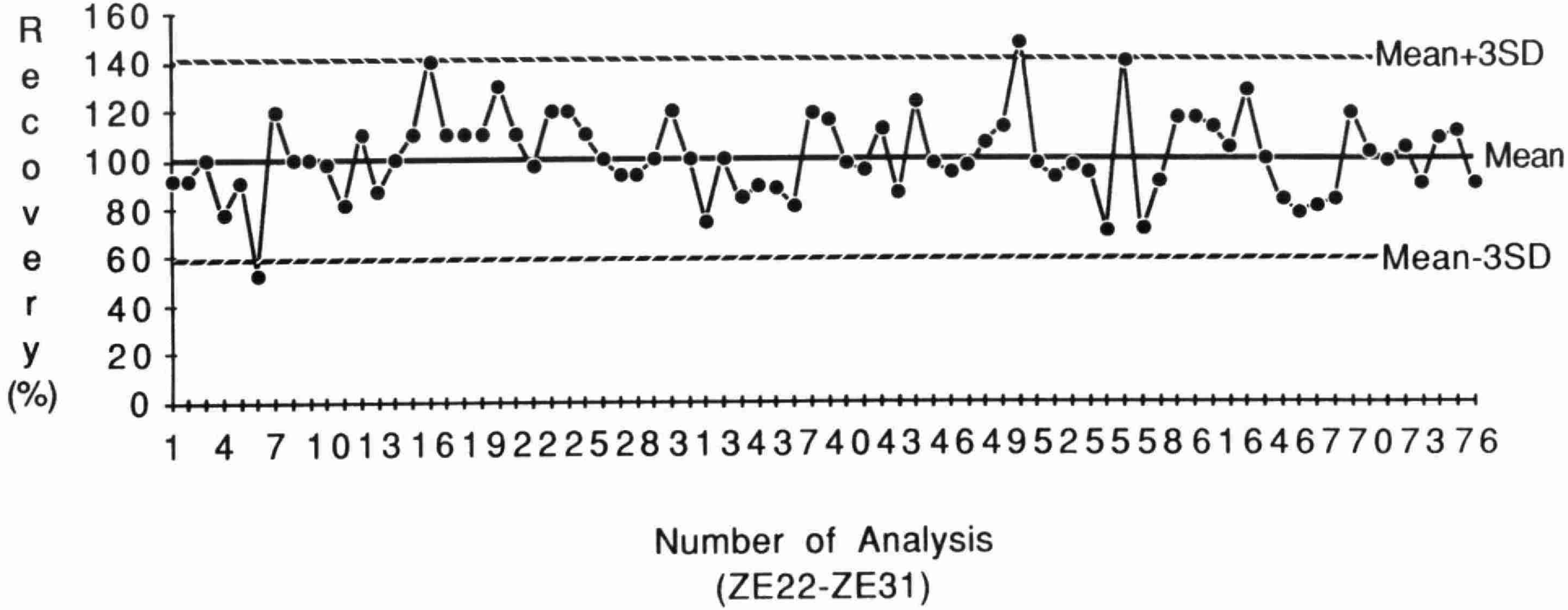


Fig. 2.2.3.1.13b

# VOASURROGATE BROMOFLUOROBENZENE RECOVERY
## (Raw Sewage)

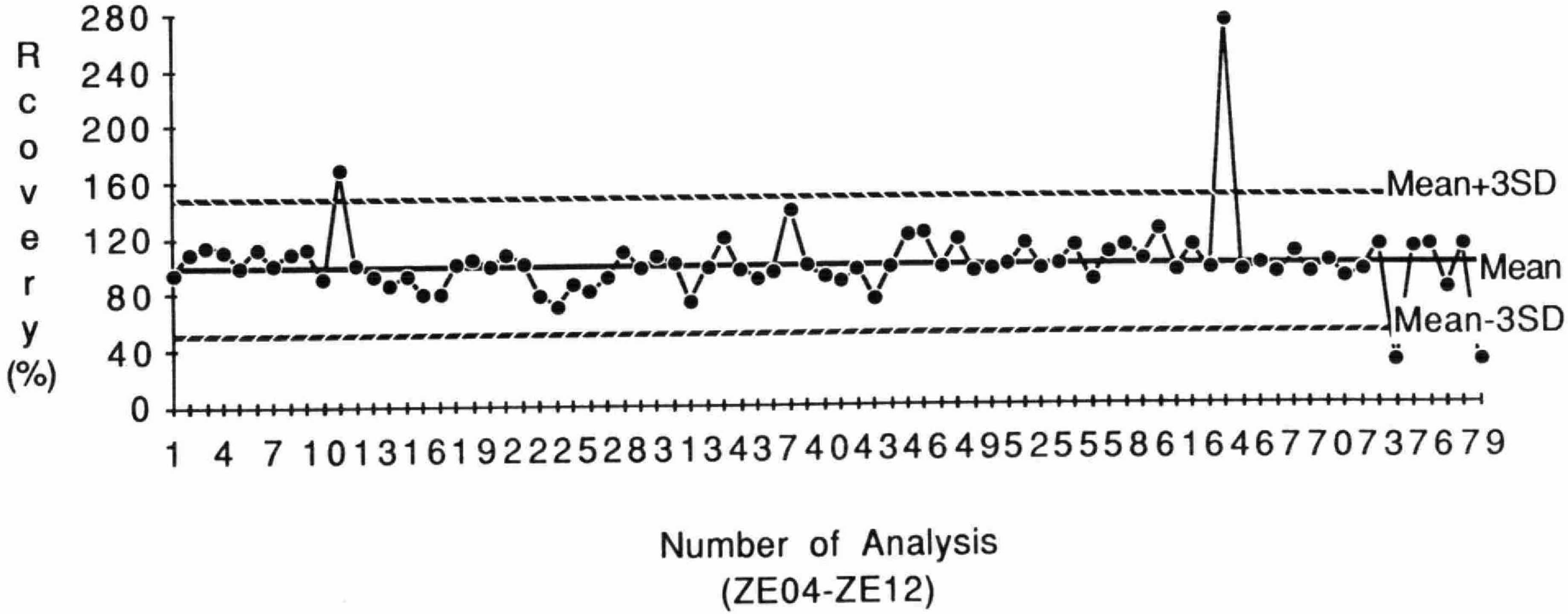


Fig. 2.2.3.1.14

VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
(Raw Sewage)

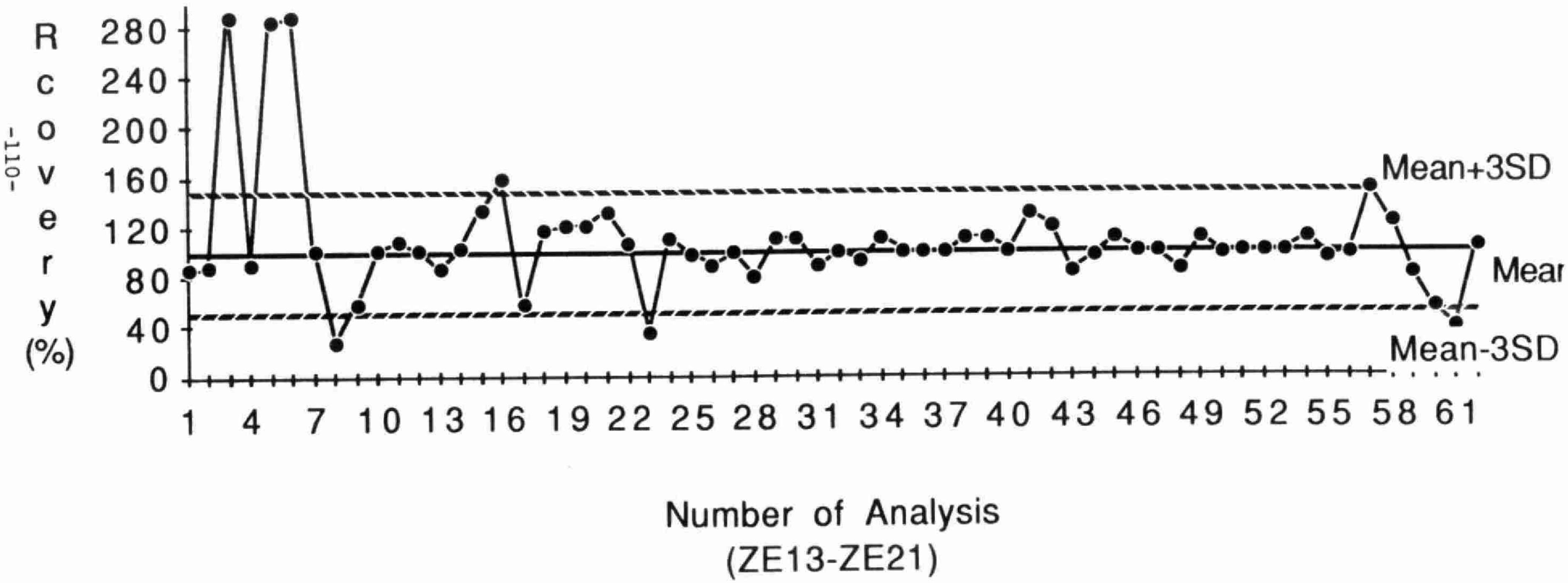


Fig. 2.2.3.1.14a

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Raw Sewage)

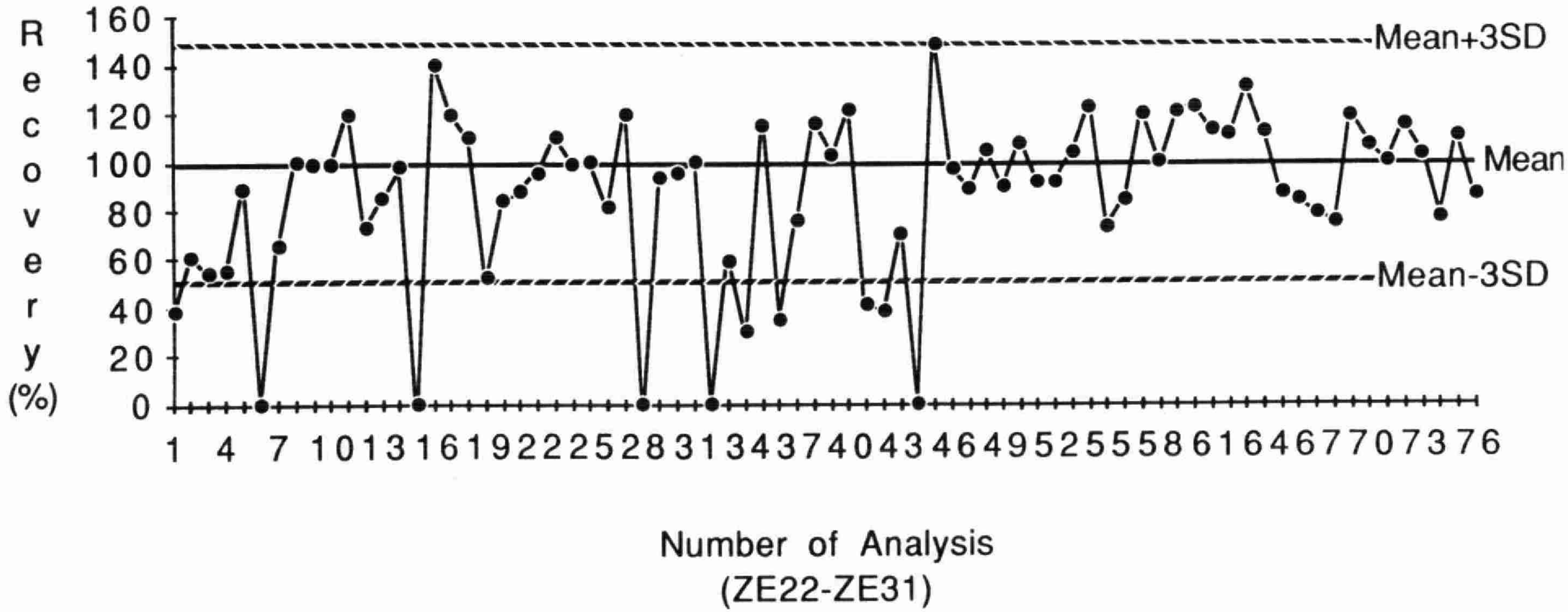


Fig. 2.2.3.1.14b

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# VOASURROGATE d8-TOLUENE RECOVERY
(Raw Sewage)

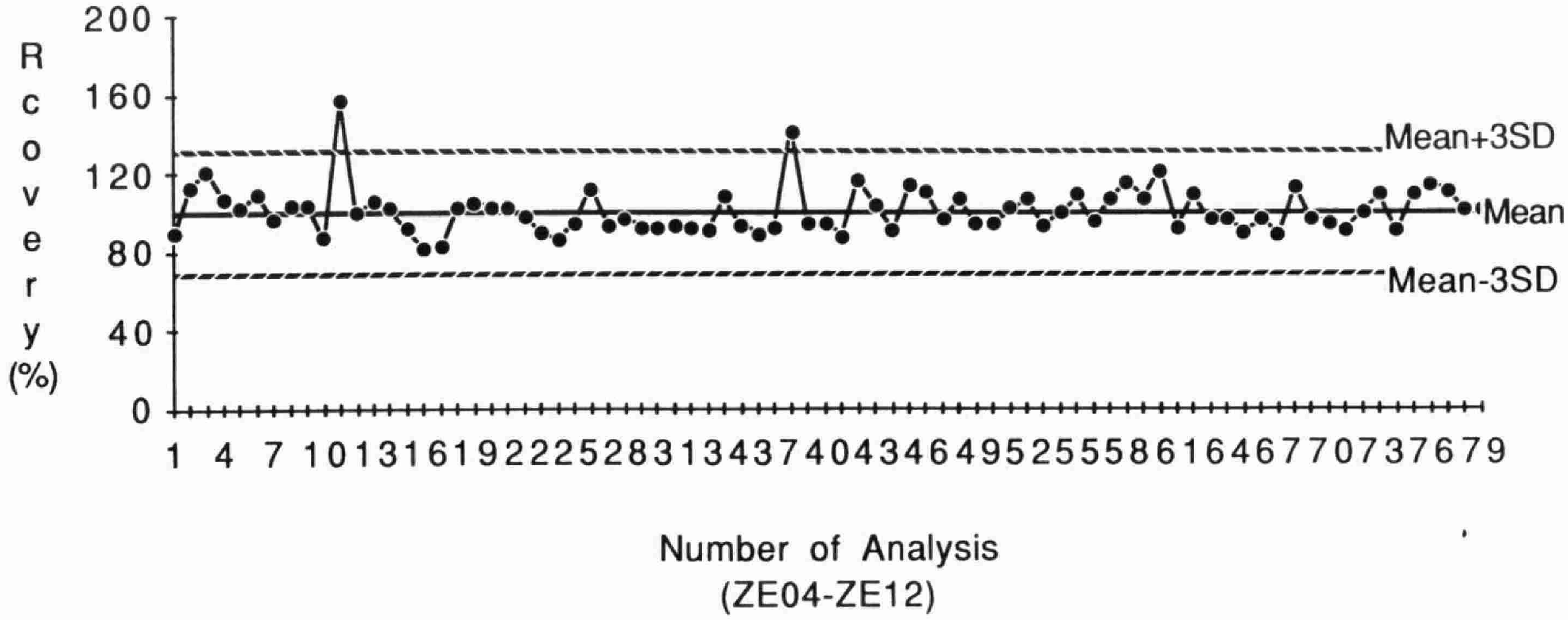



Fig. 2.2.3.1.15

# VOA SURROGATE d8-TOLUENE RECOVERY
(Raw Sewage)

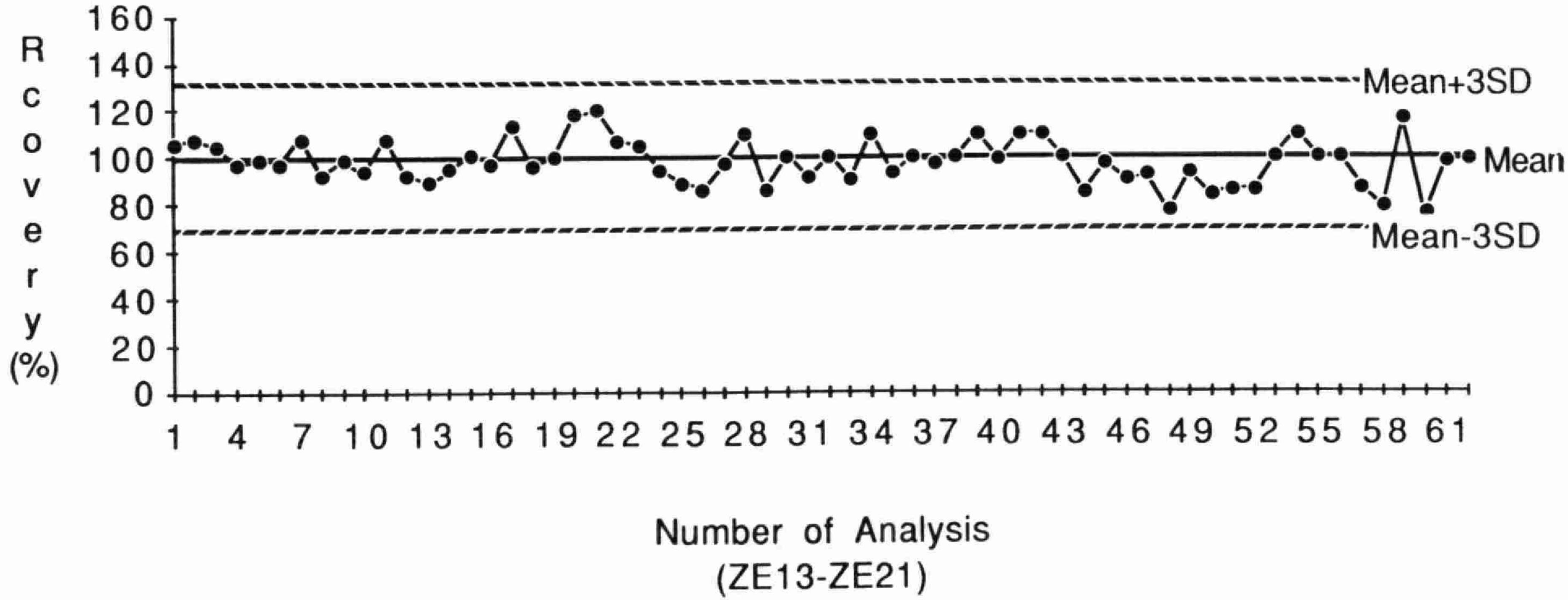





Fig. 2.2.3.1.15a

# VOA SURROGATE d8-TOLUENE RECOVERY
## (Raw Sewage)



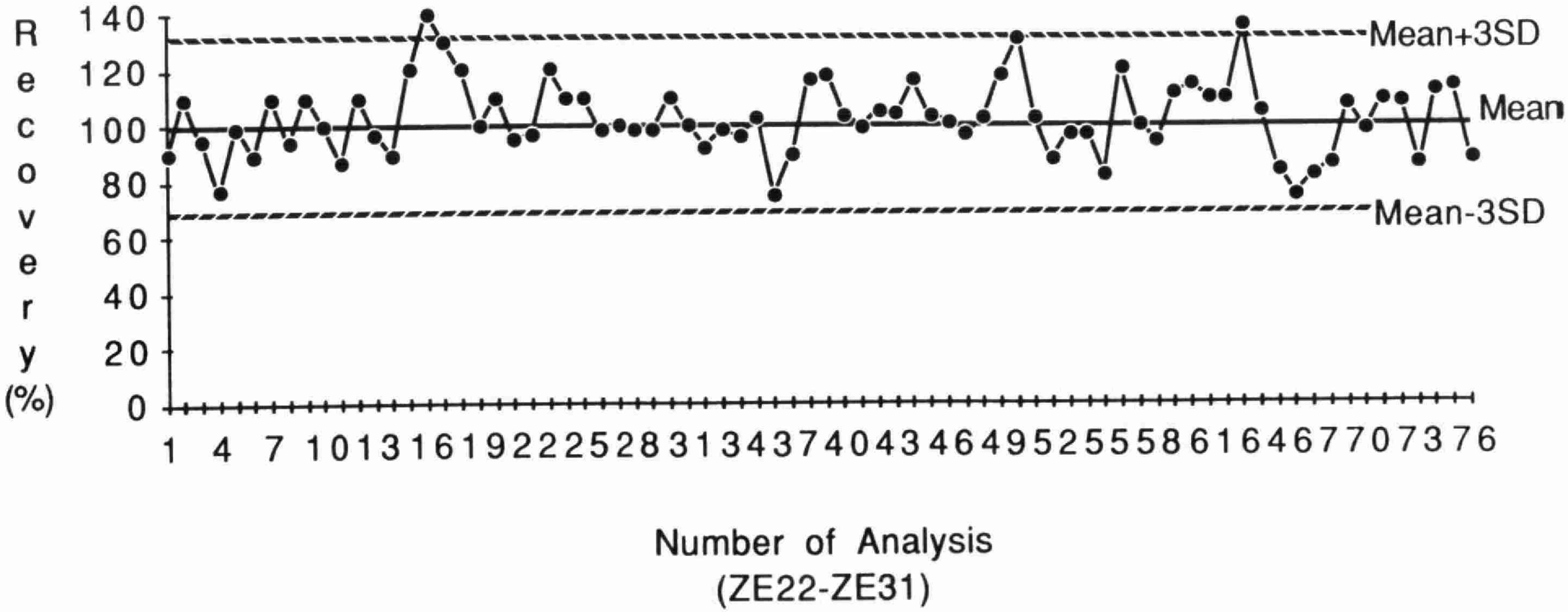



Fig. 2.2.3.1.15b

# VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Raw Sewage)

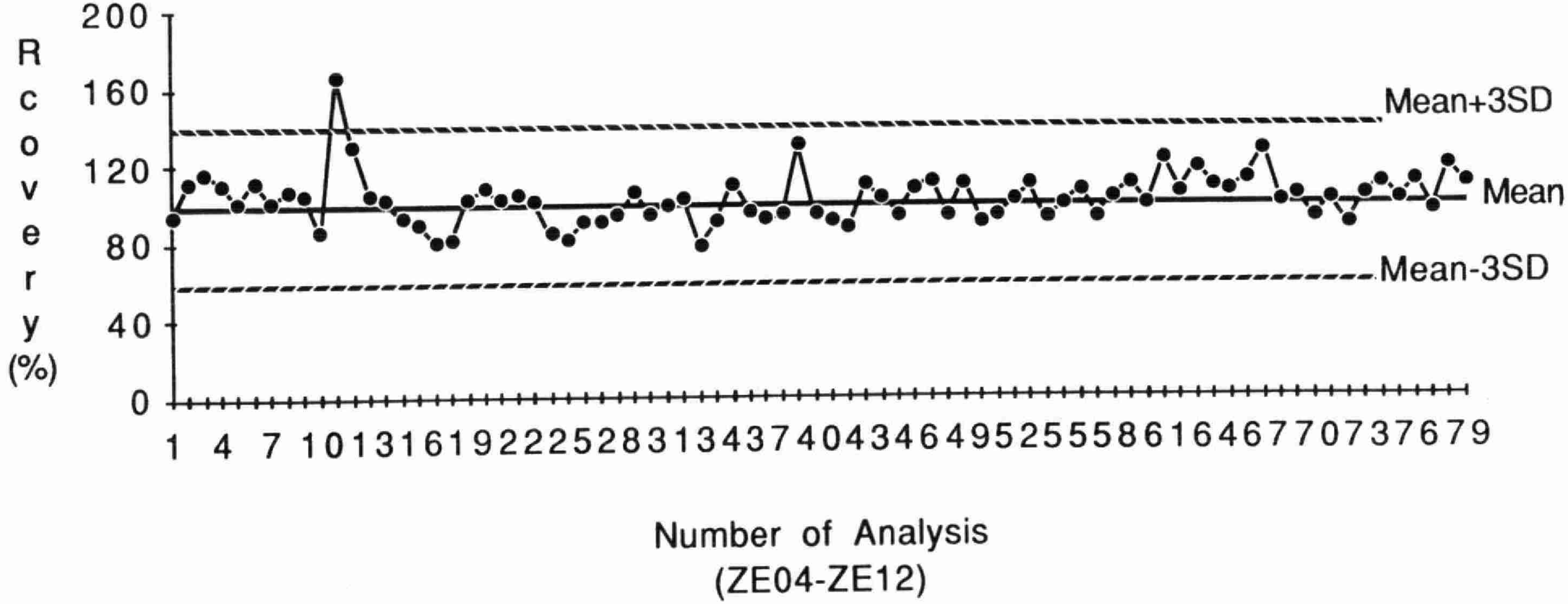



Fig. 2.2.3.1.16

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Raw Sewage)

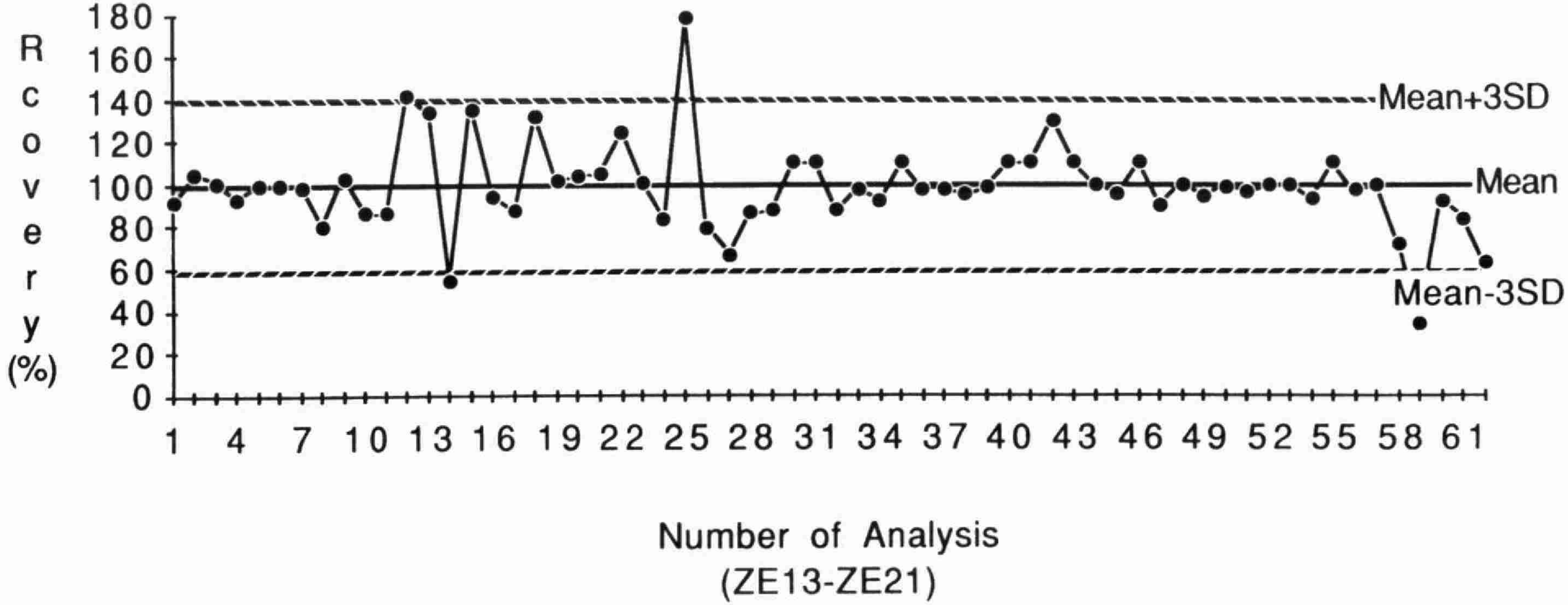



Fig. 2.2.3.1.16a

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Raw Sewage)

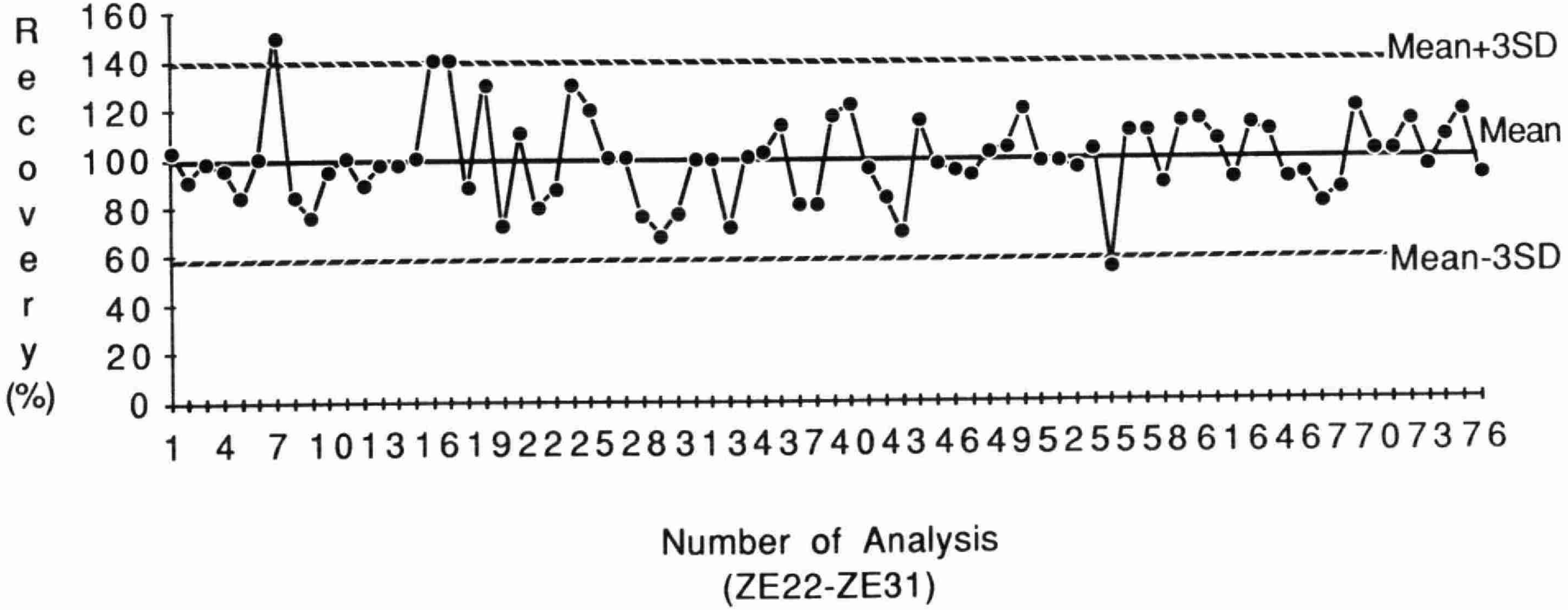



Fig. 2.2.3.1.16b

## VOA SURROGATE d4-DICHLOROETHANE RECOVERY
## (Sludge)

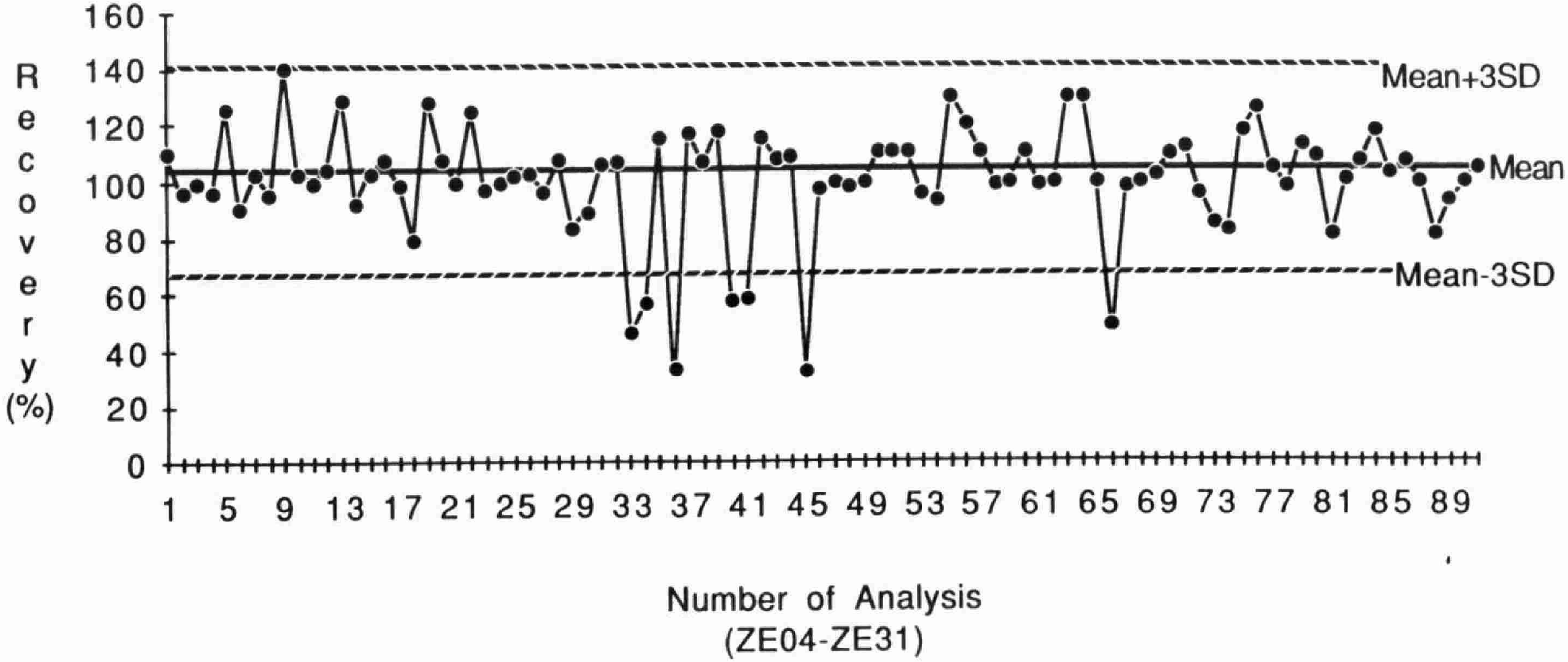



Fig. 2.2.3.1.17

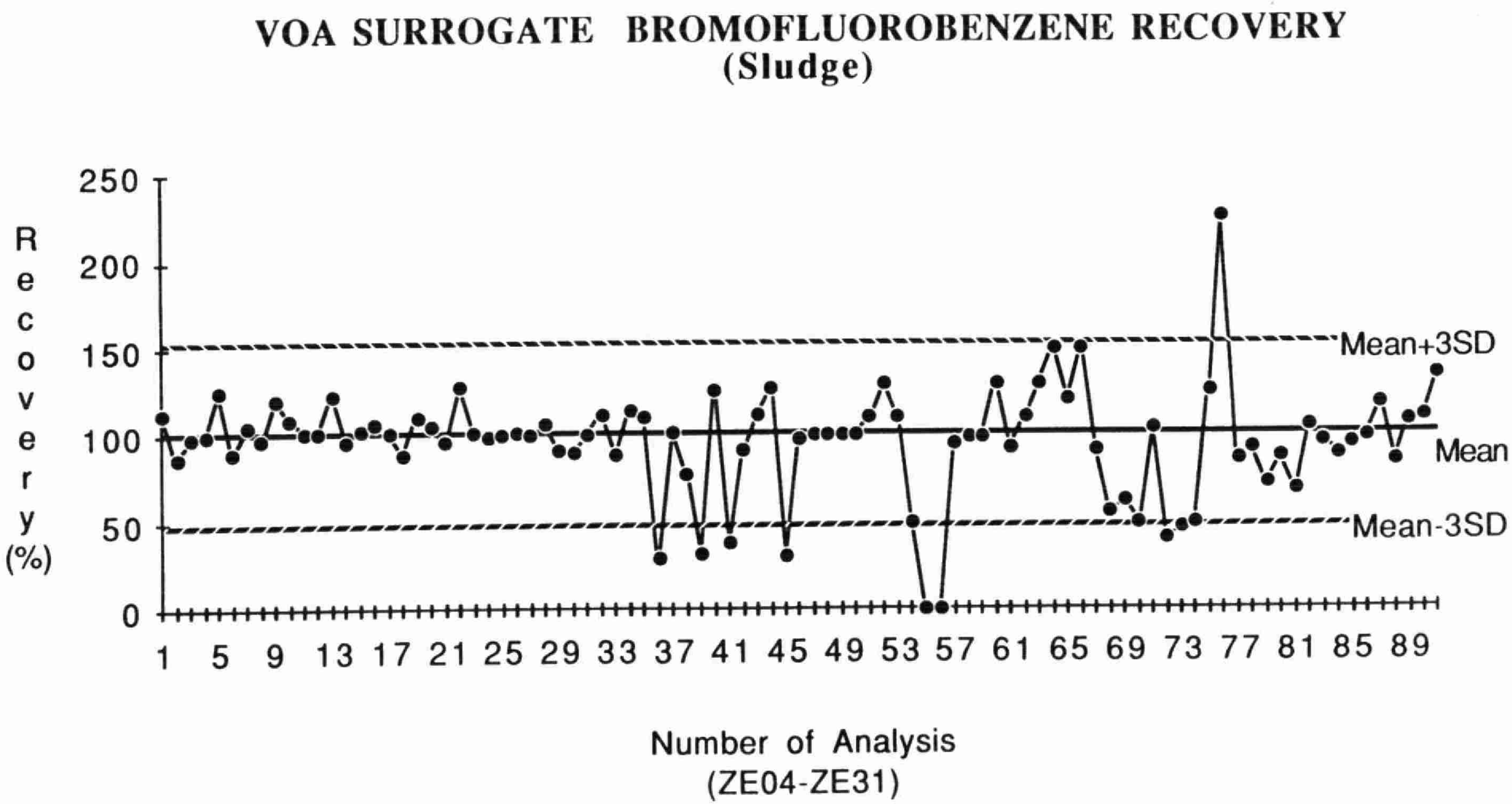

VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
(Sludge)
Recovery (%)
250
200
150
100
50
0
Mean+3SD
Mean
Mean-3SD
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85 89
Number of Analysis
(ZE04-ZE31)

Fig. 2.2.3.1.18

# VOA SURROGATE d8-TOLUENE RECOVERY
## (Sludge)

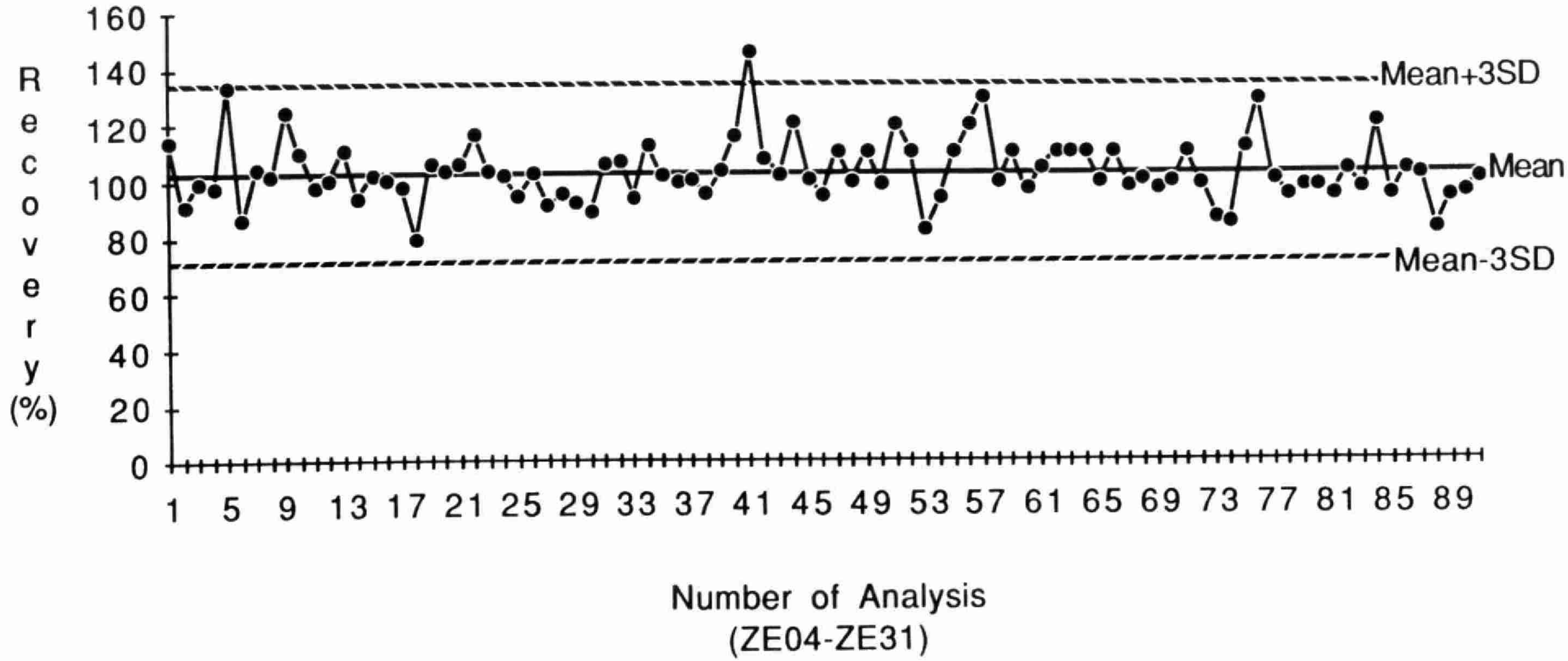



Fig. 2.2.3.1.19

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Sludge)

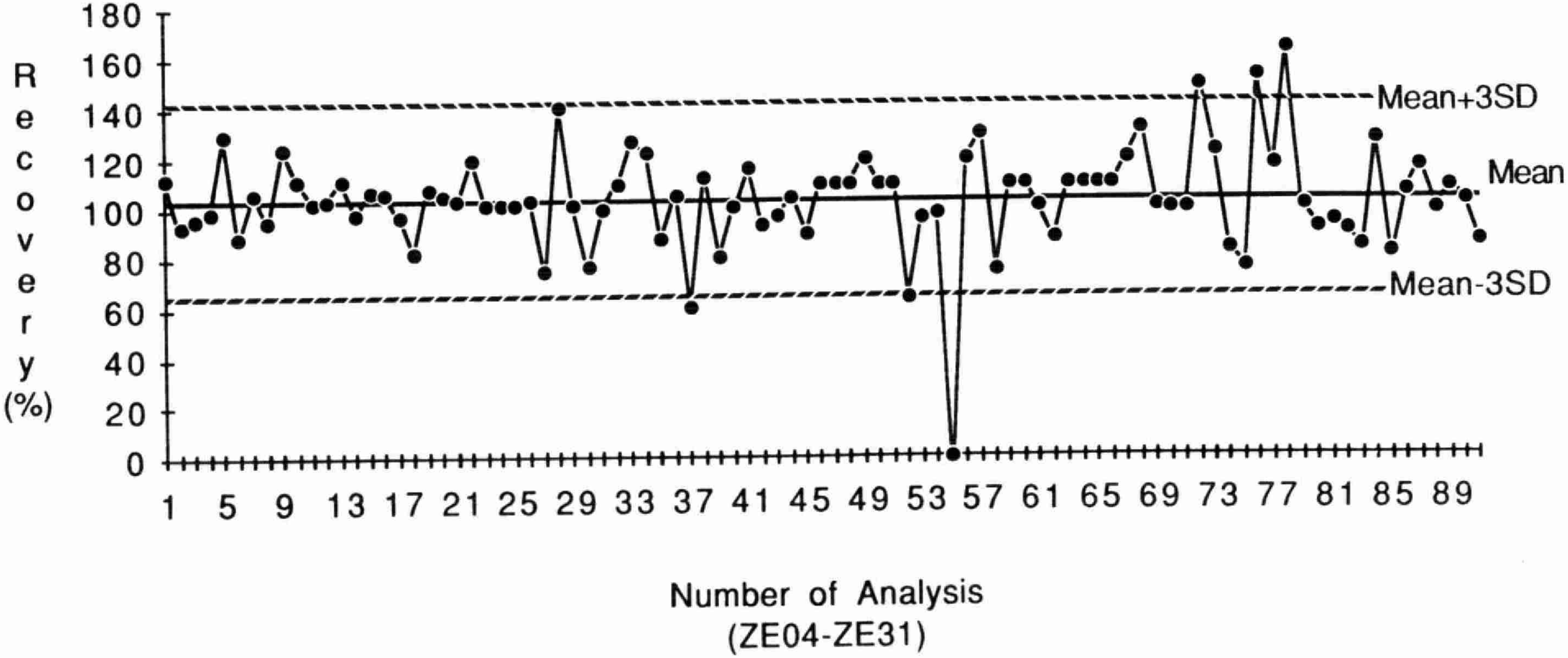



Fig. 2.2.3.1.20

## VOA SURROGATE d4-DICHLOROETHANE RECOVERY
## (Water Spike)

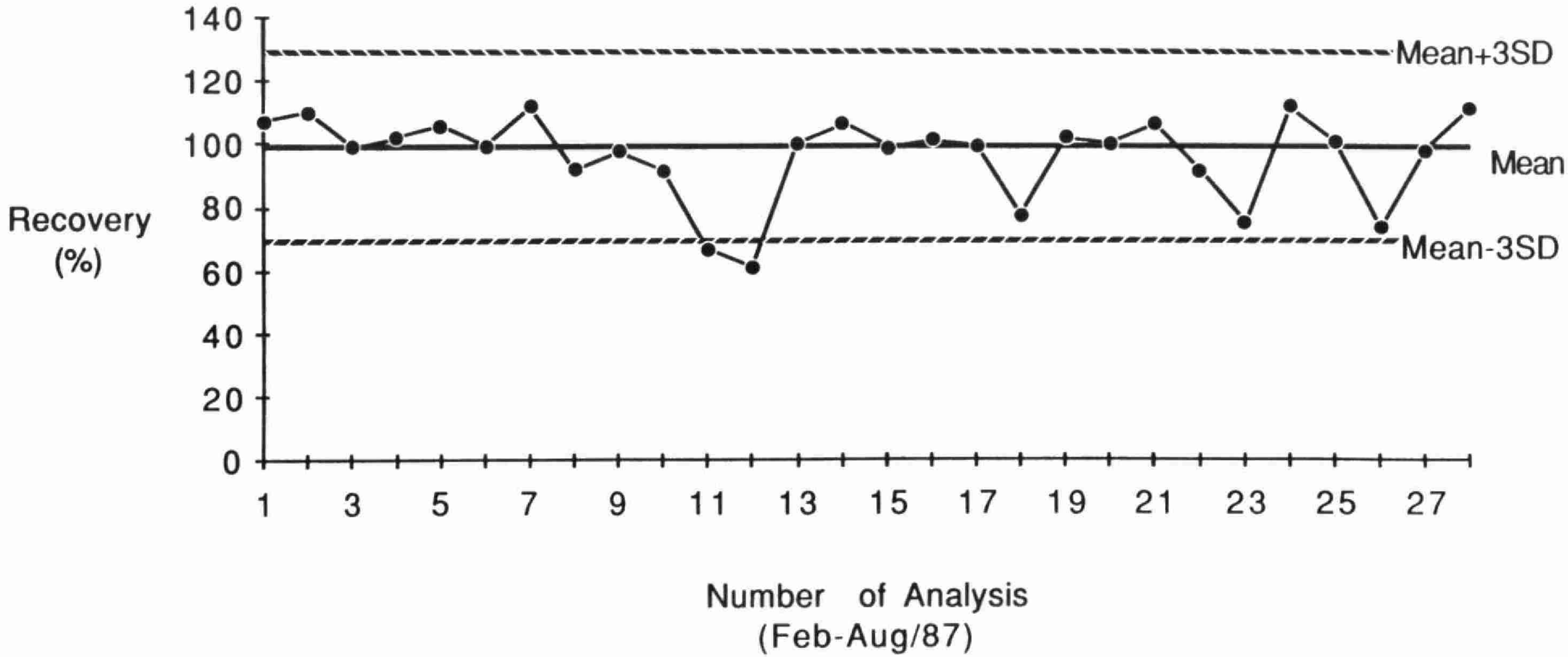



Fig. 2.2.3.1.21

## VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
(Water Spike)

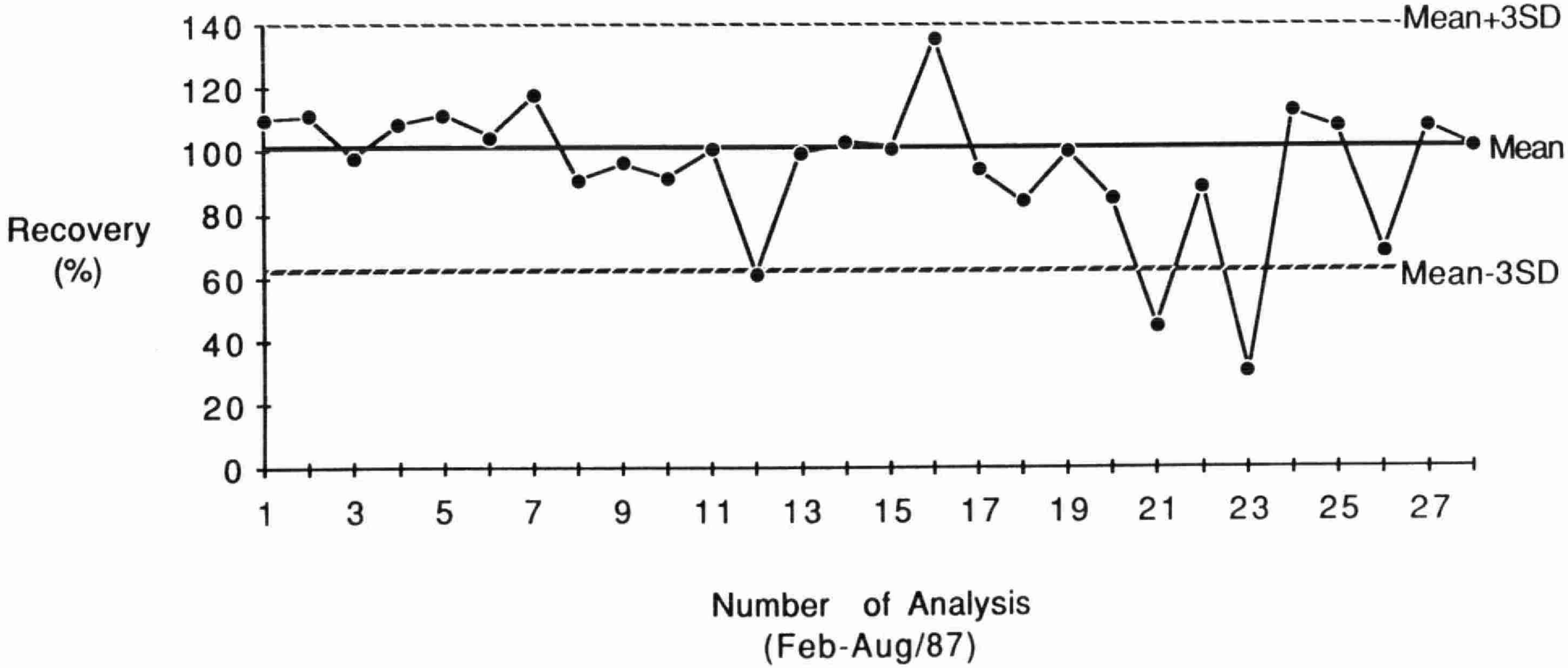



Fig. 2.2.3.1.22

# VOA SURROGATE d8-TOLUENE RECOVERY
(Water Spike)

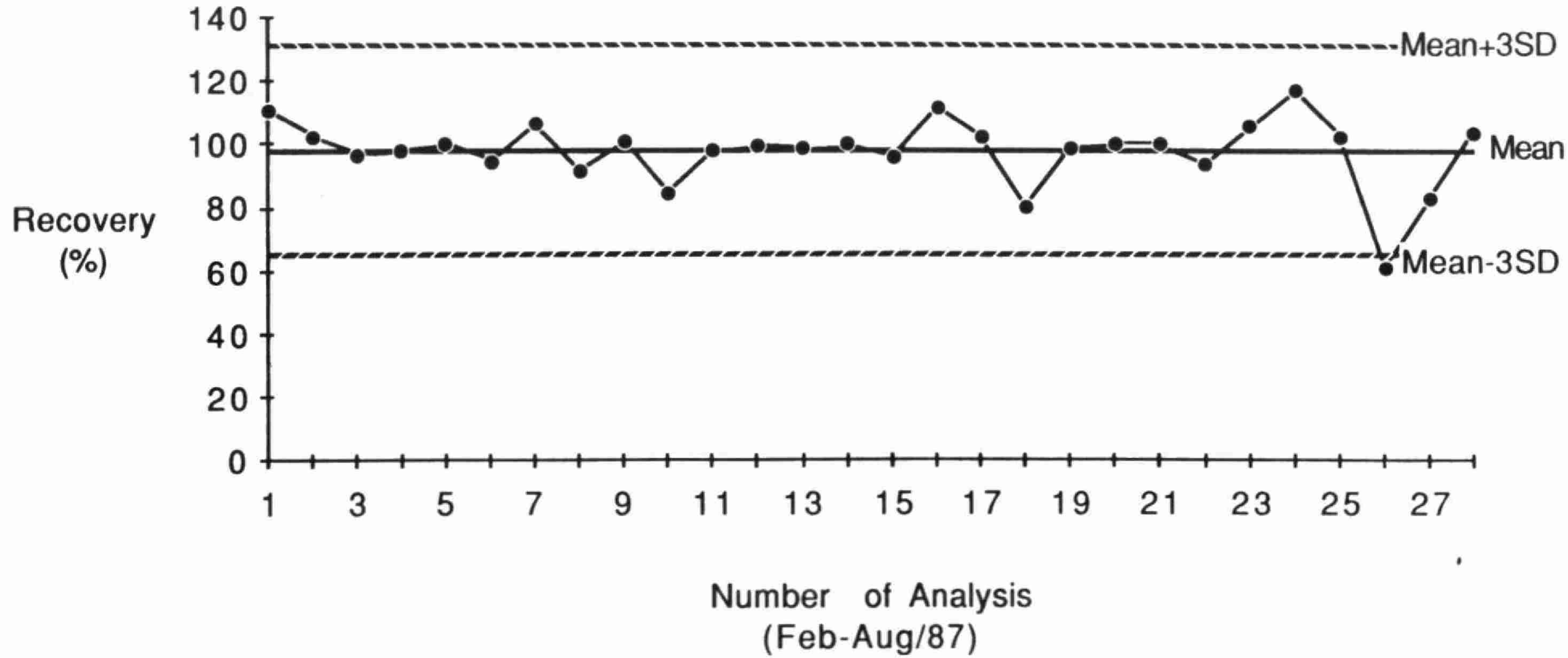



Fig. 2.2.3.1.23

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Water Spike)

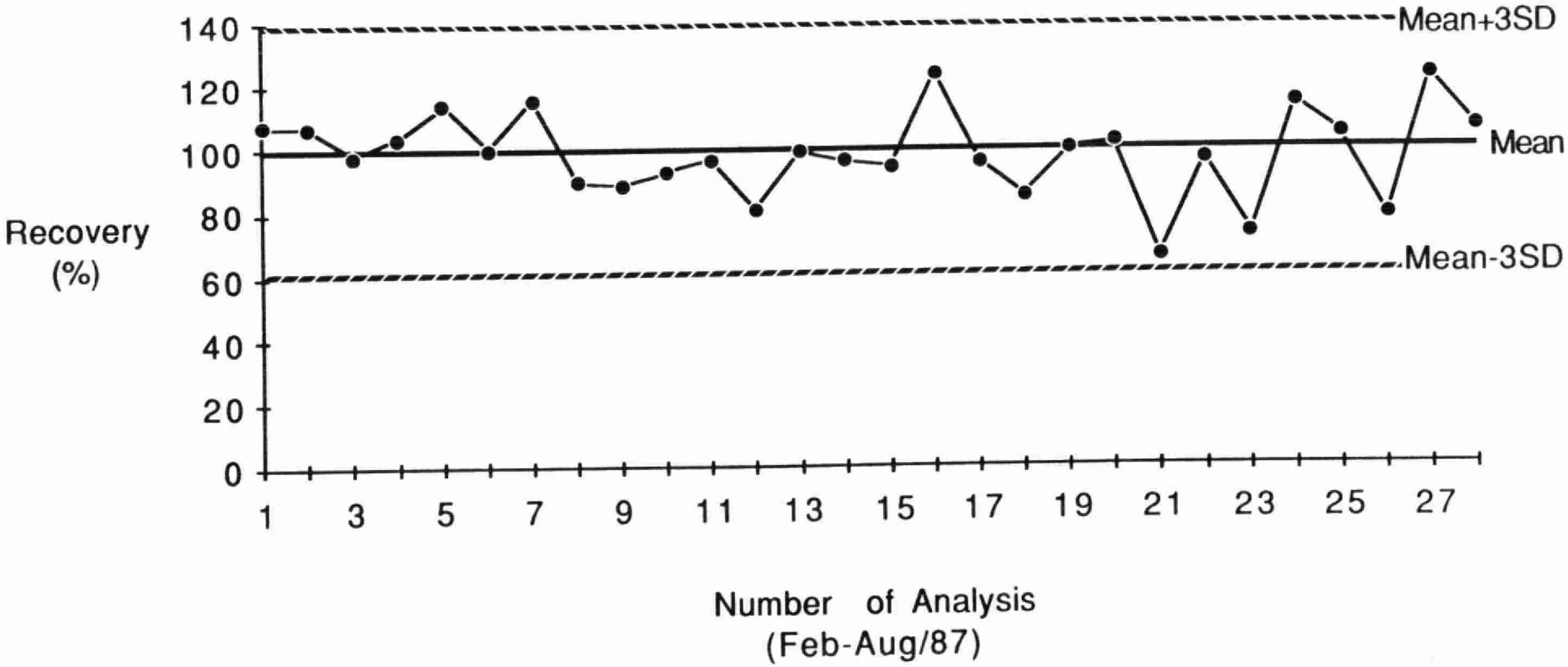



Fig. 2.2.3.1.24

## VOA SURROGATE d4-DICHLOROETHANE RECOVERY (Method Blank)

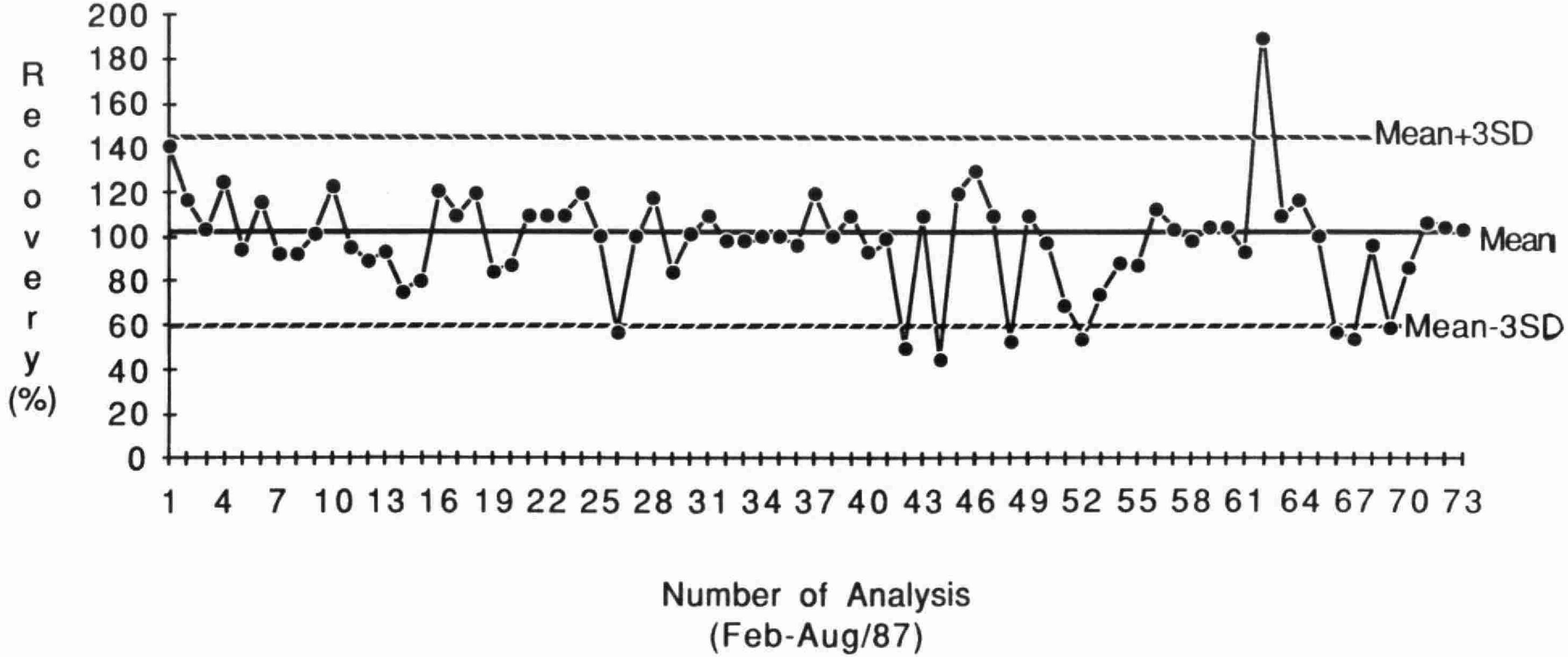



Fig. 2.2.3.1.25

# VOA SURROGATE BROMOFLUOROBENZENE RECOVERY
## (Method Blank)

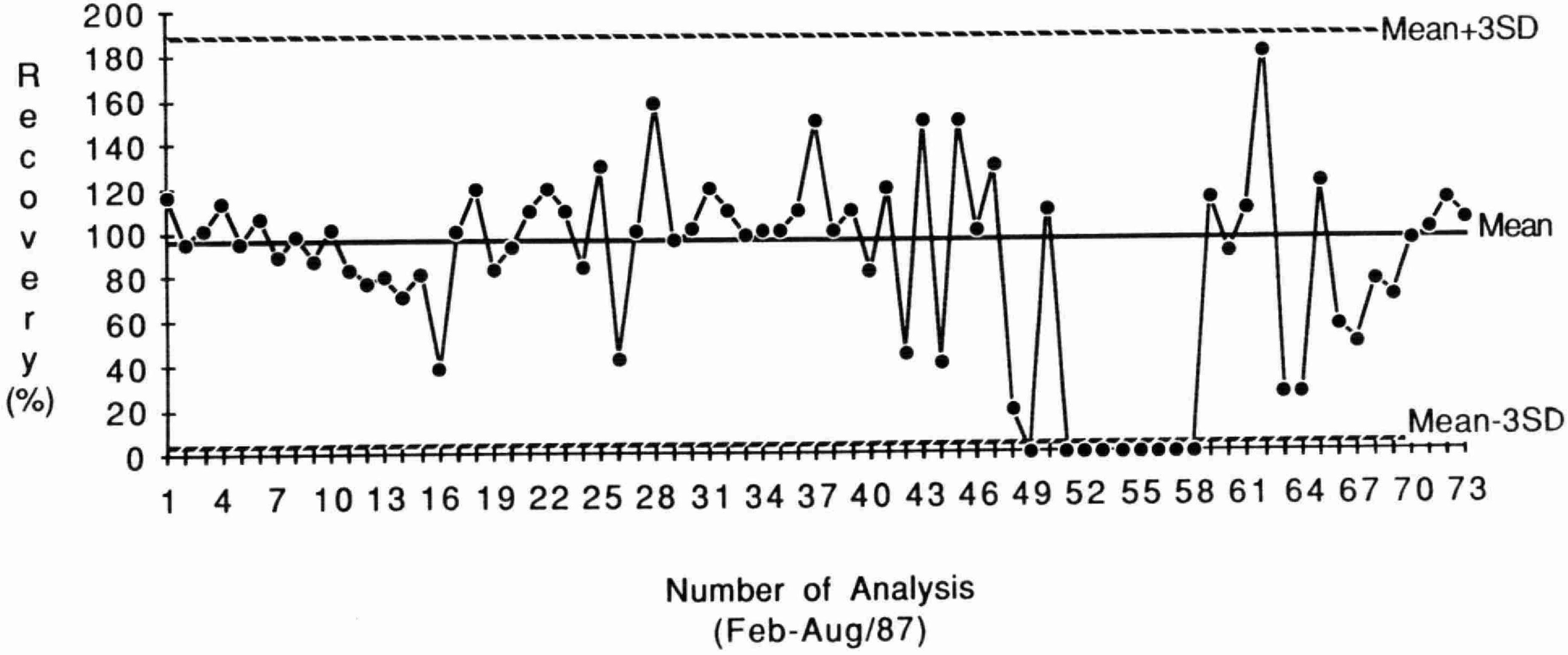



Fig. 2.2.3.1.26

# VOA SURROGATE d8-TOLUENE RECOVERY
## (Method Blank)

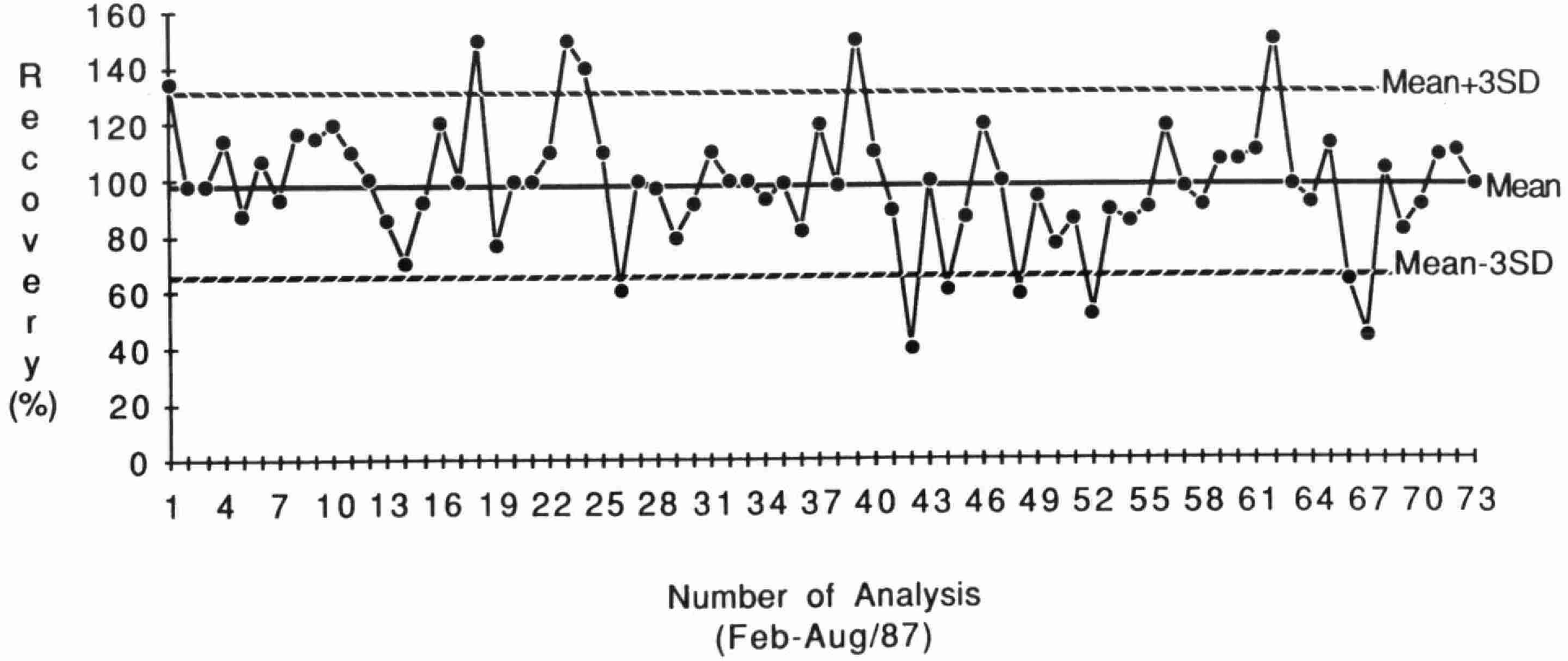



Fig. 2.2.3.1.27

## VOA SURROGATE d5-CHLOROBENZENE RECOVERY
(Method Blank)

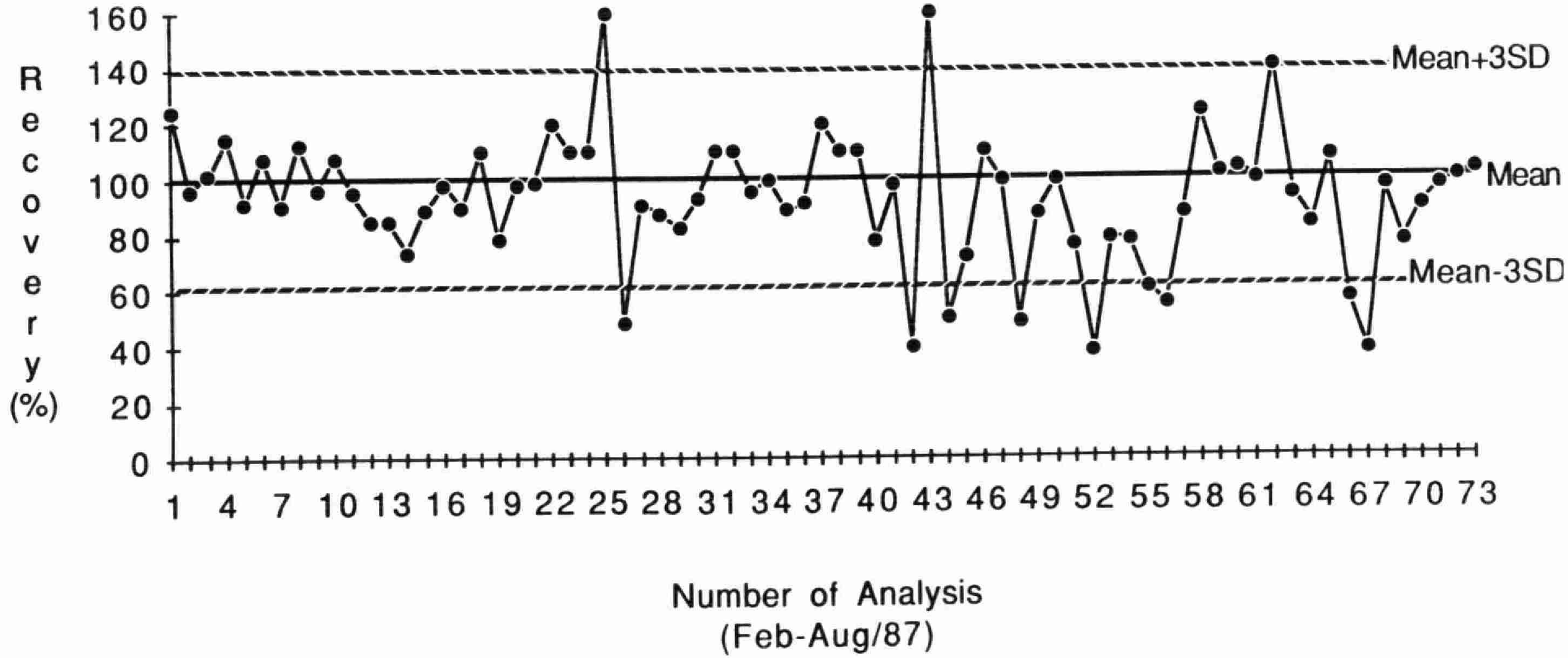



Fig. 2.2.3.1.28

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Primary Final Effluent)

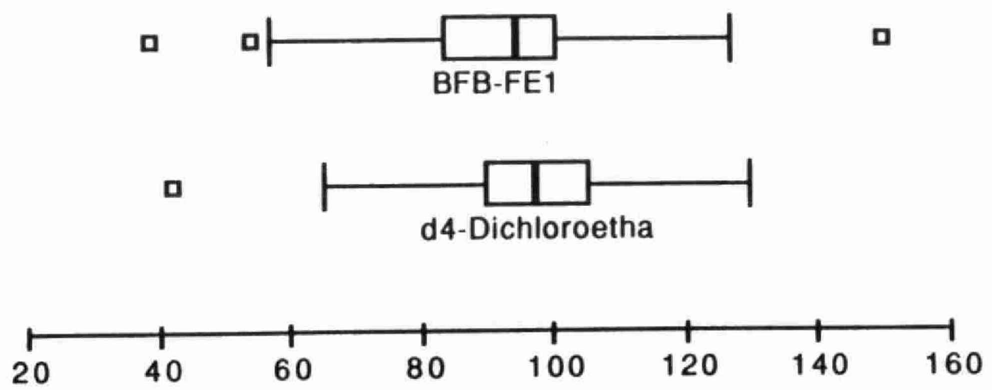



Fig. 2.2.3.1.29

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Primary Final Effluent)

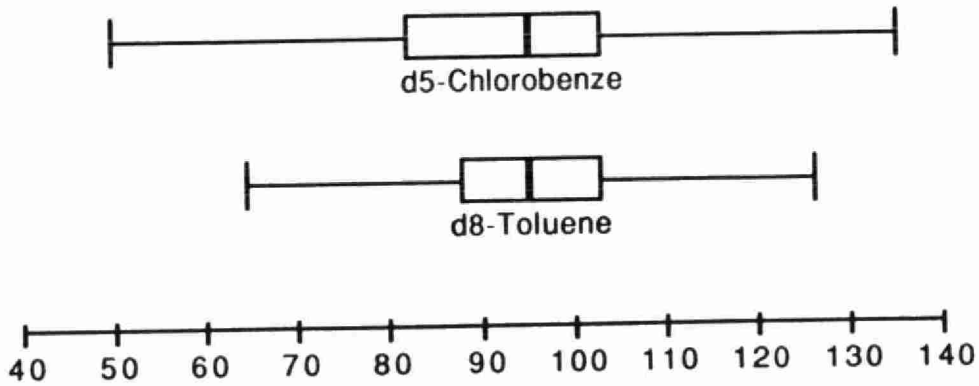





Fig. 2.2.3.1.30

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Secondary Final Effluent)



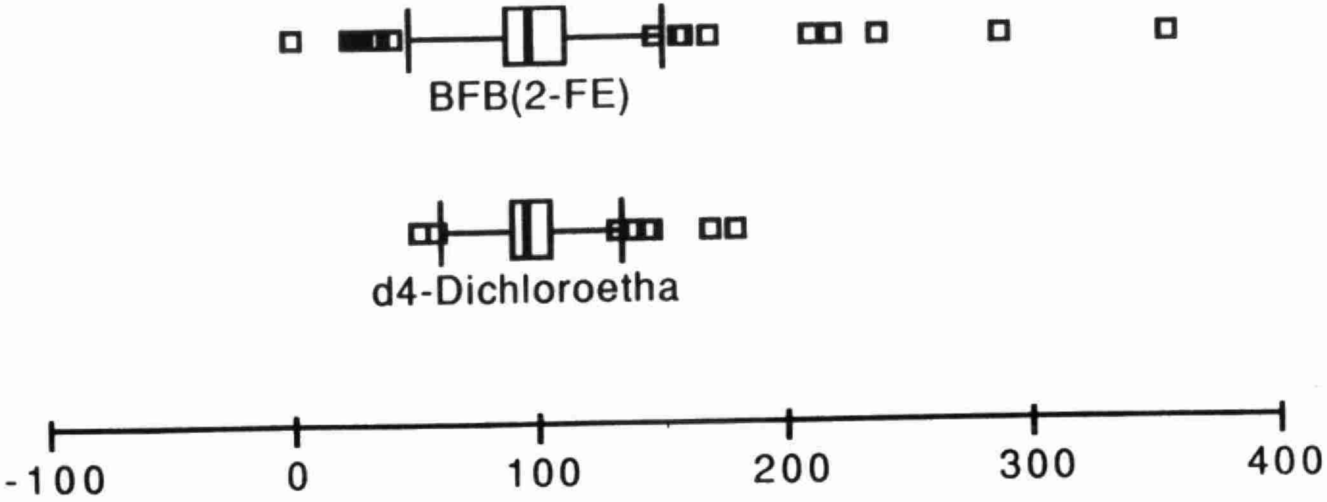



Fig. 2.2.3.1.31

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Secondary Final Effluent)

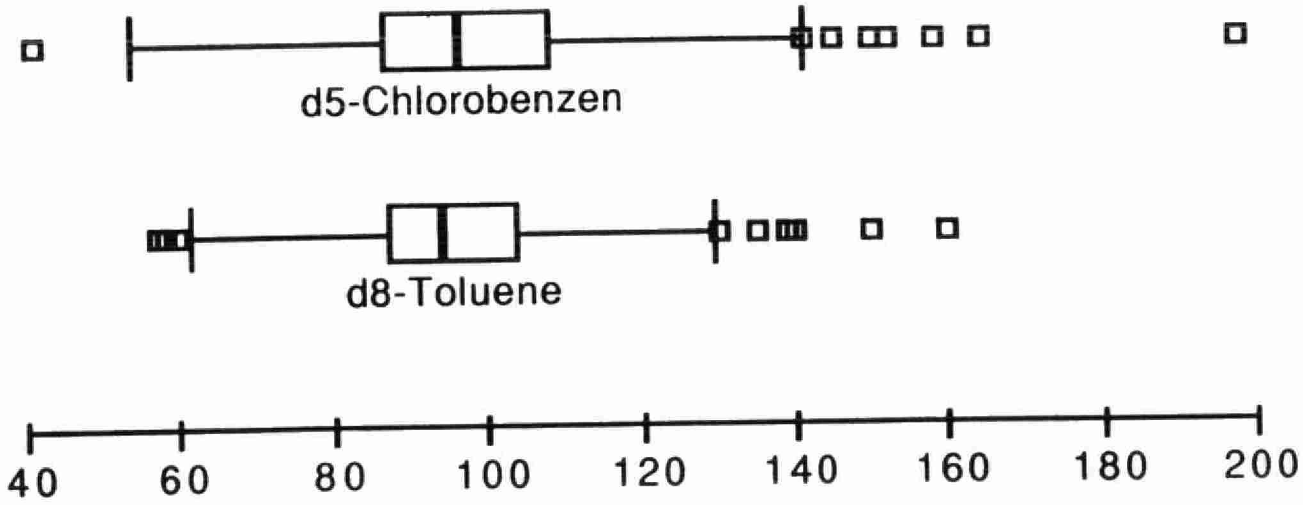



Fig. 2.2.3.1.32

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Return Recycle)

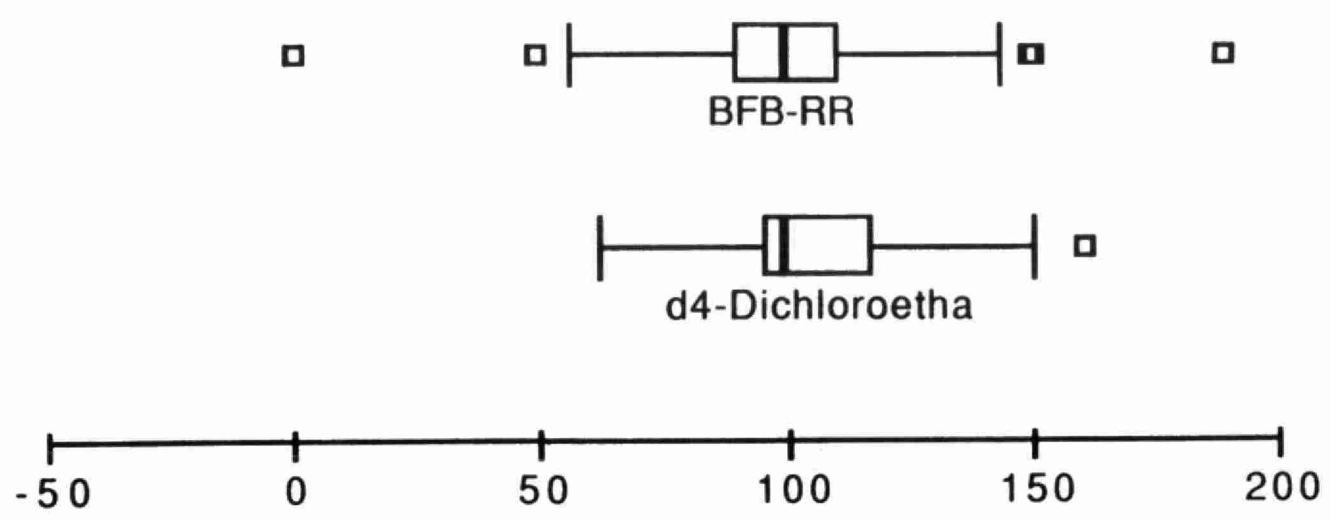



Fig. 2.2.3.1.33

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Return Recycle)

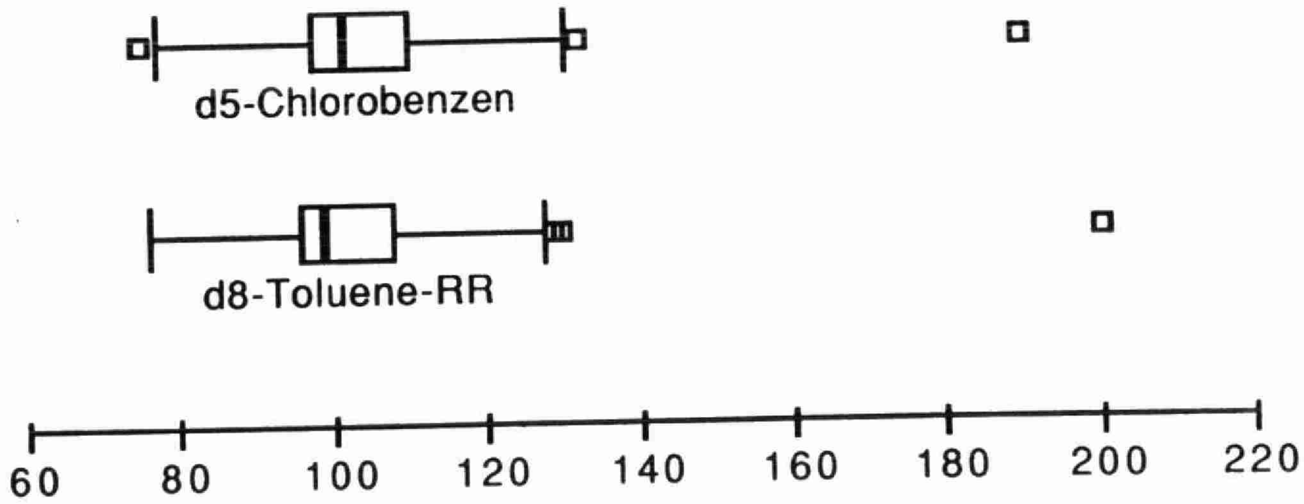



Fig. 2.2.3.1.34

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Raw Sewage)

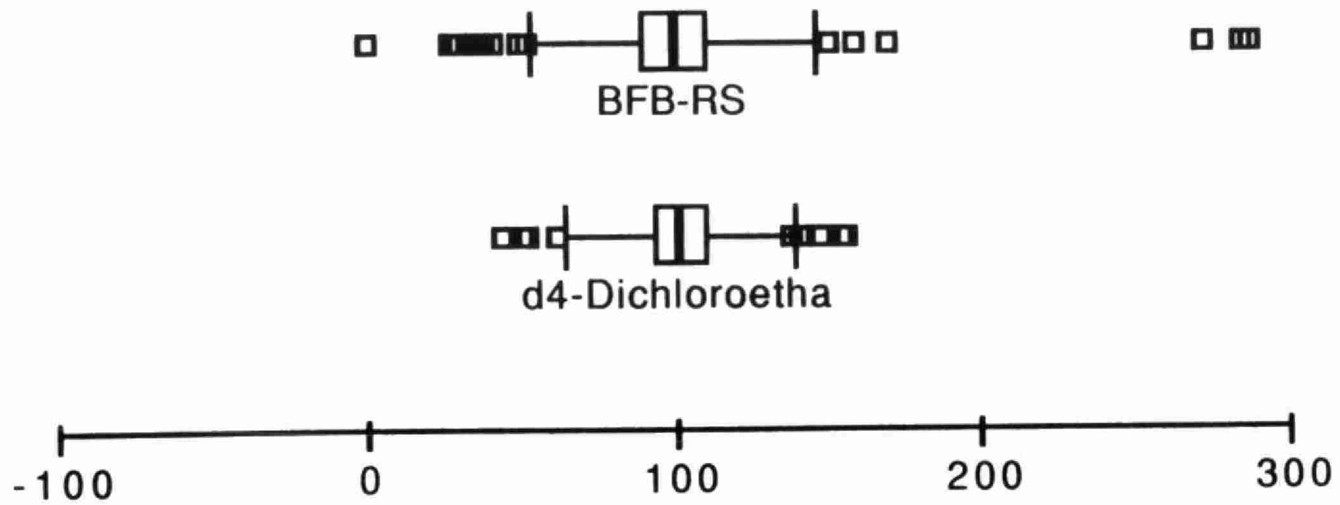



Fig. 2.2.3.1.35

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Raw Sewage)

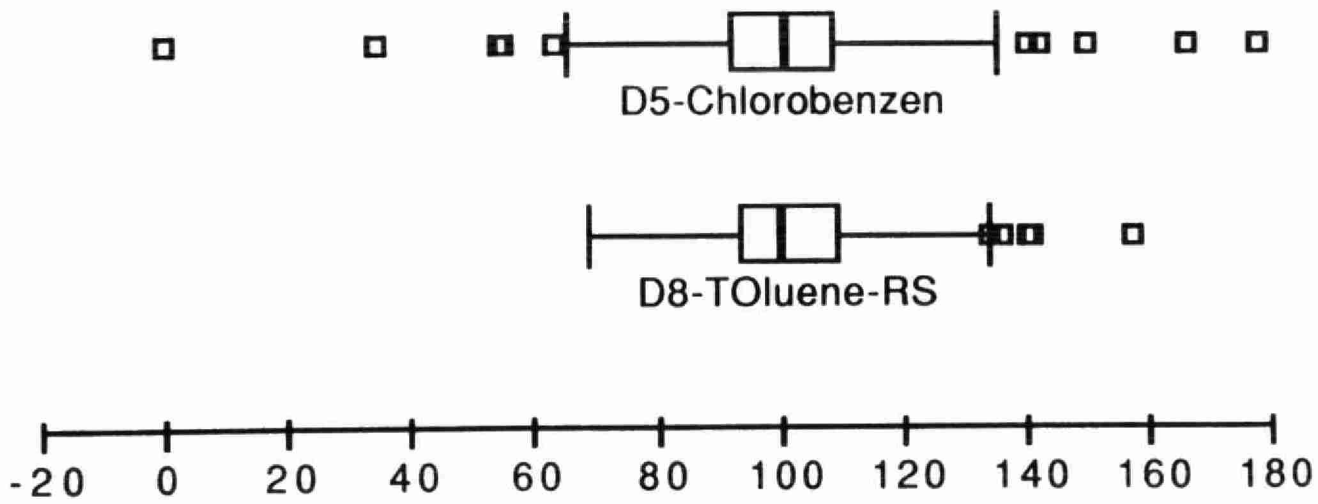



Fig. 2.2.3.1.36

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Sludge)

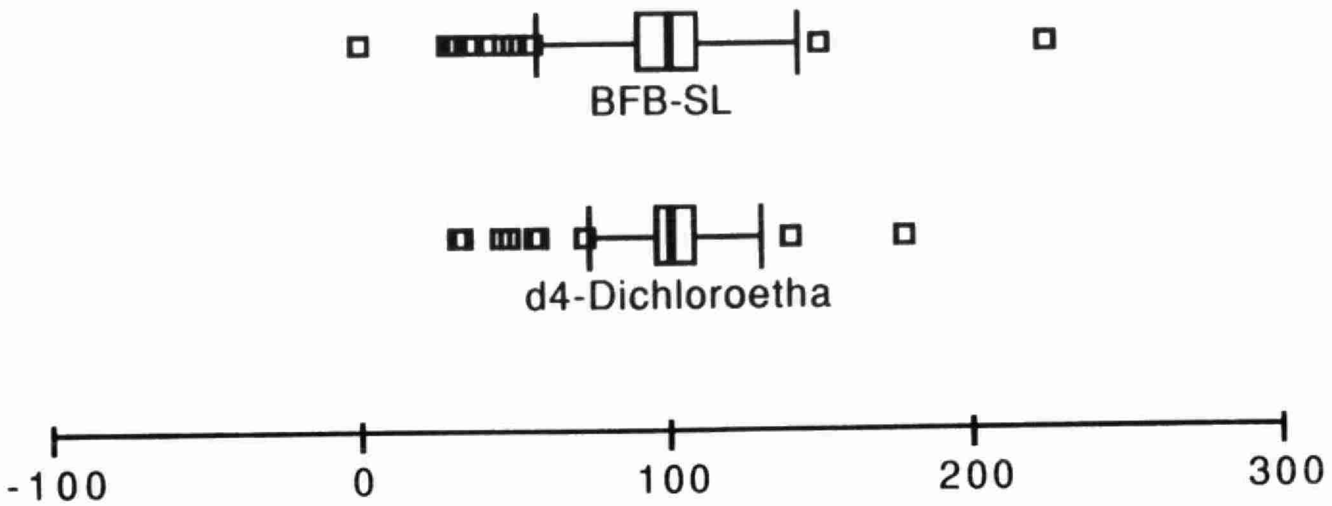



Fig. 2.2.3.1.37

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Sludge)

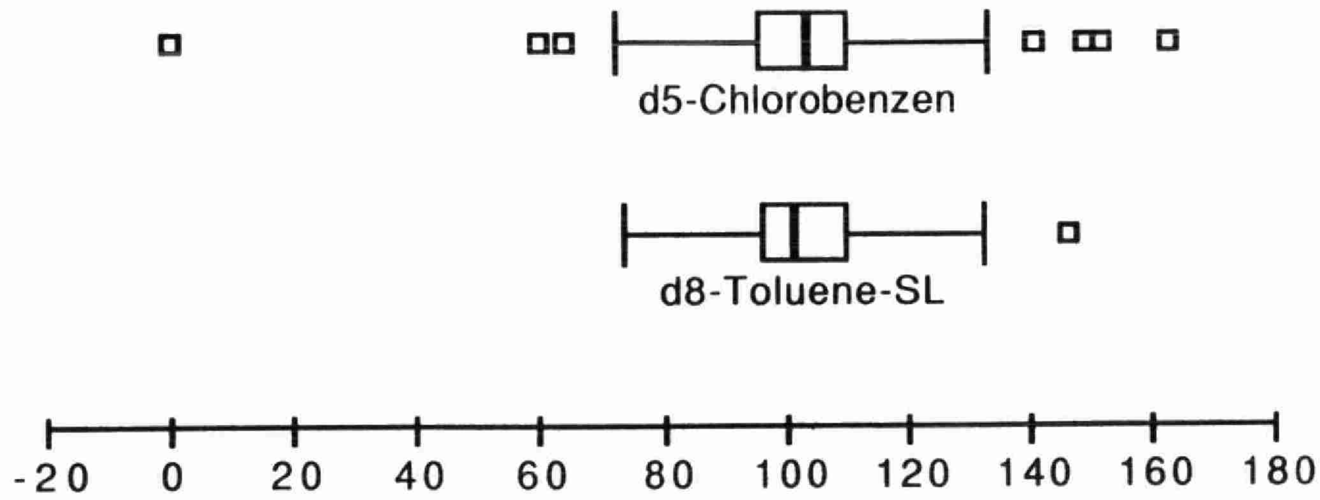





Fig. 2.2.3.1.38

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Water Spike)

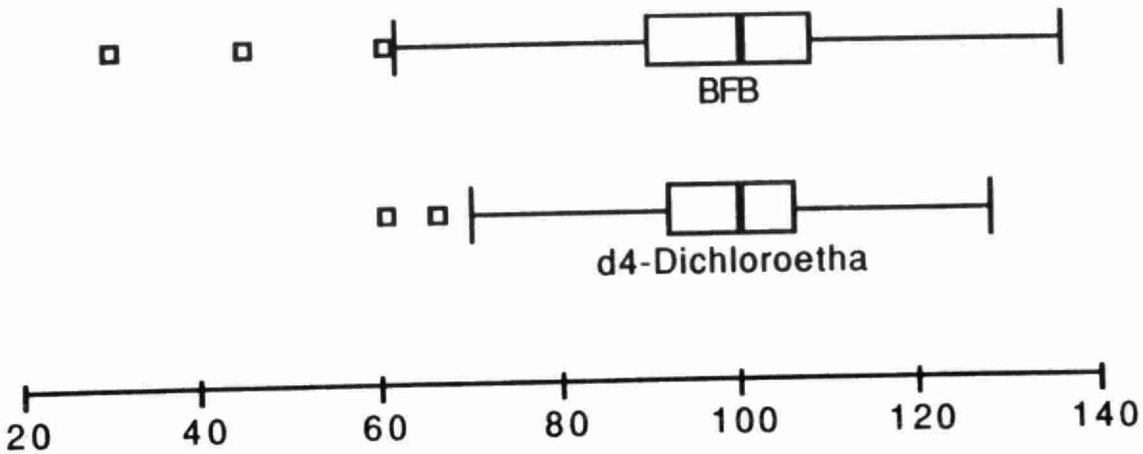





Fig. 2.2.3.1.39

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Water Spike)

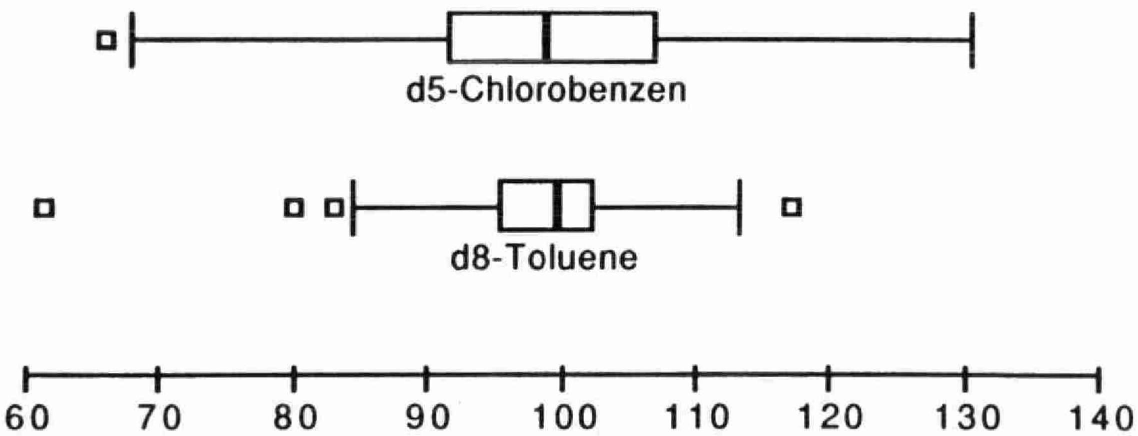



Fig. 2.2.3.1.40

Bromofluorobenzene and d4-Dichloroethane Surrogate Recovery
Box-Whisker Metthod
(Method Blank)

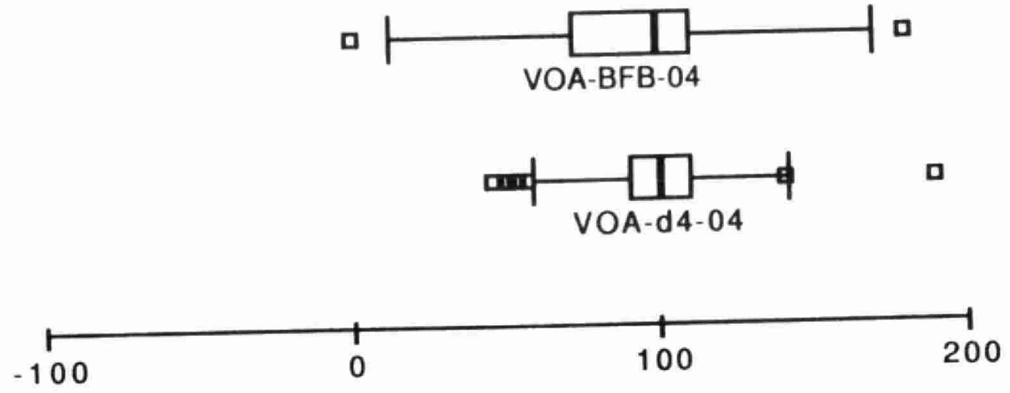



Fig. 2.2.3.1.41

d8-Toluene and d5-Chlorobenzene Surrogate Recovery
Box-Whisker Metthod
(Method Blank)

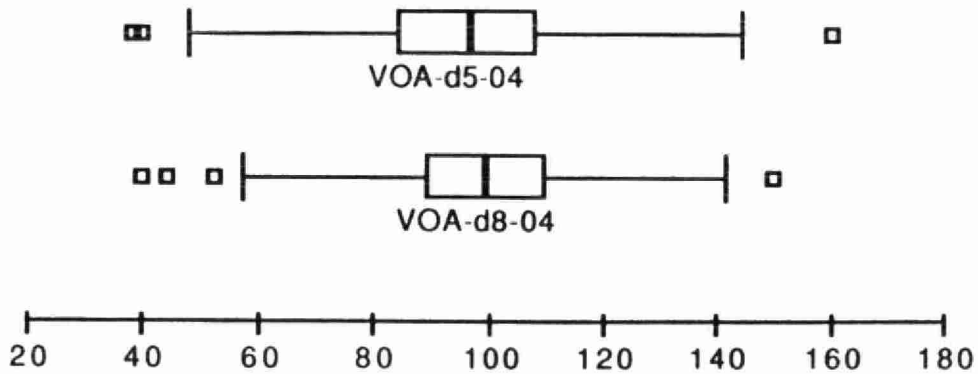



Fig. 2.2.3.1.42

## Comparison of $d_4$-Dichloroethane Recovery (Primary Final Effluent/Secondary Fianl Effluent)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4- (2-FE) | d4 (1-FE) |
|---|---|---|
| Mean: | 95.585 | 97.057 |
| Std. Deviation: | 16.147 | 12.186 |
| Observations: | 230 | 35 |

| | | |
|---|---|---|
| t-statistic: | -0.517 | Hypothesis: |
| Degrees of Freedom: | 263 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.605 | Ha: $\mu1 \neq \mu2$ |

<u>Conclusion:</u>

There was no significant difference of $d_4$-dichloroethane surrogate recovery between primary and secondary final effluent samples.

Table 2.2.3.1.9

## Comparison of $d_4$-Dichloroethane Recovery (Primary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (1-FE) | d4 (RS) |
|---|---|---|
| Mean: | 97.057 | 99.859 |
| Std. Deviation: | 12.186 | 13.898 |
| Observations: | 35 | 212 |

| | | |
|---|---|---|
| t-statistic: | -1.123 | Hypothesis: |
| Degrees of Freedom: | 245 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.262 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $d_4$-dichloroethane surrogate recovery between primary final effluent and raw sewage samples.

Table 2.2.3.1.10

## Comparison of $d_4$-Dichloroethane Recovery
## (Primary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (1-FE) | d4 (SL) |
|---|---|---|
| Mean: | 97.057 | 103.169 |
| Std. Deviation: | 12.186 | 13.349 |
| Observations: | 35 | 83 |

| | | |
|---|---|---|
| t-statistic: | -2.329 | Hypothesis: |
| Degrees of Freedom: | 116 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.022 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_4$-dichloroethane surrogate standard from sludge samples than primary final effluent samples.

Table 2.2.3.1.11

## Comparison of $d_4$-Dichloroethane Recovery
## (Primary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (1-FE) | d4 (RR) |
|---|---|---|
| Mean: | 97.057 | 103.100 |
| Std. Deviation: | 12.186 | 17.462 |
| Observations: | 35 | 43 |

Hypothesis:
Ho: $\mu1 = \mu2$
Ha: $\mu1 \neq \mu2$

t-statistic: -1.732
Degrees of Freedom: 76
Significance: 0.087

Conclusion:

There was a significantly higher ($P<0.1$) recover
$d_4$-dichloroethane surrogate standard from ret
samples than primary final effluent samples.

## Comparison of $d_4$-Dichloroethane Recovery (Secondary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4- (2-FE) | d4 (SL) |
|---|---|---|
| Mean: | 95.585 | 103.169 |
| Std. Deviation: | 16.147 | 13.349 |
| Observations: | 230 | 83 |

| | | |
|---|---|---|
| t-statistic: | -3.831 | Hypothesis: |
| Degrees of Freedom: | 311 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.000 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_4$-dichloroethane surrogate standard from sludge samples than secondary final effluent samples.

Table 2.2.3.1.13

## Comparison of $d_4$-Dichloroethane Recovery (Secondary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4- (2-FE) | d4 (RS) |
|---|---|---|
| Mean: | 95.585 | 99.859 |
| Std. Deviation: | 16.147 | 13.898 |
| Observations: | 230 | 212 |

| | | |
|---|---|---|
| t-statistic: | -2.971 | Hypothesis: |
| Degrees of Freedom: | 440 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.003 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_4$-dichloroethane surrogate standard from raw sewage samples than secondary final effluent samples.

Table 2.2.3.1.14

## Comparison of $d_4$-Dichloroethane Recovery (Secondary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4- (2-FE) | d4 (RR) |
|---|---|---|
| Mean: | 95.585 | 103.100 |
| Std. Deviation: | 16.147 | 17.462 |
| Observations: | 230 | 43 |

| | | |
|---|---|---|
| t-statistic: | -2.765 | Hypothesis: |
| Degrees of Freedom: | 271 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.006 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_4$-dichloroethane surrogate standard from return recycle samples than secondary final effluent samples.

Table 2.2.3.1.15

## Comparison of $d_4$-Dichloroethane Recovery
## (Raw Sewage/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (RS) | d4 (SL) |
|---|---|---|
| Mean: | 99.859 | 103.169 |
| Std. Deviation: | 13.898 | 13.349 |
| Observations: | 212 | 83 |

| | | |
|---|---|---|
| t-statistic: | -1.859 | Hypothesis: |
| Degrees of Freedom: | 293 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.064 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.1$) recovery of $d_4$-dichloroethane surrogate standard from sludge samples than raw sewage samples.

Table 2.2.3.1.16

## Comparison of $d_4$-Dichloroethane Recovery
## (Return Recycle/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (RR) | d4 (SL) |
|---|---|---|
| Mean: | 103.100 | 103.169 |
| Std. Deviation: | 17.462 | 13.349 |
| Observations: | 43 | 83 |

| | | |
|---|---|---|
| t-statistic: | -0.025 | Hypothesis: |
| Degrees of Freedom: | 124 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.980 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $d_4$-dichloroethane surrogate recovery between return recycle and sludge samples.

Table 2.2.3.1.17

## Comparison of $d_4$-Dichloroethane Recovery
## (Raw Sewage/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d4 (RS) | d4 (RR) |
|---|---|---|
| Mean: | 99.859 | 103.100 |
| Std. Deviation: | 13.898 | 17.462 |
| Observations: | 212 | 43 |

| | | |
|---|---|---|
| t-statistic: | -1.332 | Hypothesis: |
| Degrees of Freedom: | 253 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.184 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $d_4$-dichloroethane surrogate recovery between raw sewage and return recycle samples.

Table 2.2.3.1.18

## Comparison of $d_5$-Chlorobenzene Recovery
## (Primary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (1-FE) | d5 (RR) |
|---|---|---|
| Mean: | 92.861 | 101.290 |
| Std. Deviation: | 15.760 | 11.411 |
| Observations: | 36 | 42 |

| | | |
|---|---|---|
| t-statistic: | -2.731 | Hypothesis: |
| Degrees of Freedom: | 76 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.008 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_5$-chlorobenzene surrogate standard from return recycle samples than primary final effluent samples.

Table 2.2.3.1.19

## Comparison of $d_5$-Chlorobenzene Recovery
## (Primary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (1-FE) | d5 (SL) |
|---|---|---|
| Mean: | 92.861 | 102.939 |
| Std. Deviation: | 15.760 | 12.908 |
| Observations: | 36 | 84 |

| | | |
|---|---|---|
| t-statistic: | -3.662 | Hypothesis: |
| Degrees of Freedom: | 118 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.000 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_5$-chlorobenzene surrogate standard from sludge samples than primary final effluent samples.

Table 2.2.3.1.20

## Comparison of $d_5$-Chlorobenzene Recovery
## (Primary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (1-FE) | d5 (RS) |
|---|---|---|
| Mean: | 92.861 | 98.697 |
| Std. Deviation: | 15.760 | 13.633 |
| Observations: | 36 | 208 |

| | | |
|---|---|---|
| t-statistic: | -2.316 | Hypothesis: |
| Degrees of Freedom: | 242 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.021 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_5$-chlorobenzene surrogate standard from raw sewage samples than primary final effluent samples.

Table 2.2.3.1.21

## Comparison of $d_5$-Chlorobenzene Recovery (Secondary Final Effluent/Primary Final Effluent)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5- (2-FE) | d5 (1-FE) |
|---|---|---|
| Mean: | 96.084 | 92.861 |
| Std. Deviation: | 15.434 | 15.760 |
| Observations: | 229 | 36 |

| | | |
|---|---|---|
| t-statistic: | 1.161 | Hypothesis: |
| Degrees of Freedom: | 263 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.247 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $d_5$-chlorobenzene surrogate recovery between primary and secondary final effluent samples.

Table 2.2.3.1.22

**Comparison of $d_5$-Chlorobenzene Recovery (Secondary Final Effluent/Return Recycle)**

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5- (2-FE) | d5 (RR) |
|---|---|---|
| Mean: | 96.084 | 101.290 |
| Std. Deviation: | 15.434 | 11.411 |
| Observations: | 229 | 42 |

| | | |
|---|---|---|
| t-statistic: | -2.083 | Hypothesis: |
| Degrees of Freedom: | 269 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.038 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_5$-chlorobenzene surrogate standard from return recycle samples than secondary final effluent samples.

Table 2.2.3.1.23

## Comparison of $d_5$-Chlorobenzene Recovery (Secondary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5- (2-FE) | d5 (SL) |
|---|---|---|
| Mean: | 96.084 | 102.939 |
| Std. Deviation: | 15.434 | 12.908 |
| Observations: | 229 | 84 |

| | | |
|---|---|---|
| t-statistic: | -3.631 | Hypothesis: |
| Degrees of Freedom: | 311 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.000 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_5$-chlorobenzene surrogate standard from sludge samples than secondary final effluent samples.

Table 2.2.3.1.24

## Comparison of $d_5$-Chlorobenzene Recovery
## (Secondary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5- (2-FE) | d5 (RS) |
|---|---|---|
| Mean: | 96.084 | 98.697 |
| Std. Deviation: | 15.434 | 13.633 |
| Observations: | 229 | 208 |

| | | |
|---|---|---|
| t-statistic: | -1.868 | Hypothesis: |
| Degrees of Freedom: | 435 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.062 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.1$) recovery of $d_5$-chlorobenzene surrogate standard from raw sewage samples than secondary final effluent samples.

Table 2.2.3.1.25

## Comparison of $d_5$-Chloroabenzene Recovery (Return Recycle/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (RR) | d5 (SL) |
|---|---|---|
| Mean: | 101.290 | 102.939 |
| Std. Deviation: | 11.411 | 12.908 |
| Observations: | 42 | 84 |

| | | |
|---|---|---|
| t-statistic: | -0.702 | Hypothesis: |
| Degrees of Freedom: | 124 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.484 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $d_5$-chlorobenzene surrogate recovery between return recycle and sludge samples.

Table 2.2.3.1.26

## Comparison of $d_5$-Chlorobenzene Recovery (Raw Sewage/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (RS) | d5 (RR) |
|---|---|---|
| Mean: | 98.697 | 101.290 |
| Std. Deviation: | 13.633 | 11.411 |
| Observations: | 208 | 42 |

| | | |
|---|---|---|
| t-statistic: | -1.153 | Hypothesis: |
| Degrees of Freedom: | 248 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.250 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $d_5$-chlorobenzene surrogate recovery between raw sewage and return recycle samples.

Table 2.2.3.1.27

## Comparison of $d_5$-Chlorobenzene Recovery
## (Raw Sewage/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d5 (RS) | d5 (SL) |
|---|---|---|
| Mean: | 98.697 | 102.939 |
| Std. Deviation: | 13.633 | 12.908 |
| Observations: | 208 | 84 |

| | | |
|---|---|---|
| t-statistic: | -2.443 | Hypothesis: |
| Degrees of Freedom: | 290 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.015 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_5$-chlorobenzene surrogate standard from sludge samples than raw sewage samples.

Table 2.2.3.1.28

## Comparison of $d_8$-Toluene Recovery
## (Primary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (1-FE) | d8 (SL) |
|---|---|---|
| Mean: | 95.089 | 102.948 |
| Std. Deviation: | 12.772 | 10.514 |
| Observations: | 36 | 90 |

| | | |
|---|---|---|
| t-statistic: | -3.559 | Hypothesis: |
| Degrees of Freedom: | 124 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.001 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_8$-toluene surrogate standard from sludge samples than primary final effluent samples.

Table 2.2.3.1.29

## Comparison of $d_8$-Toluene Recovery
## (Primary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (1-FE) | d8 (RR) |
|---|---|---|
| Mean: | 95.089 | 100.217 |
| Std. Deviation: | 12.772 | 11.553 |
| Observations: | 36 | 42 |

| | | |
|---|---|---|
| t-statistic: | -1.861 | Hypothesis: |
| Degrees of Freedom: | 76 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.067 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.1$) recovery of $d_8$-toluene surrogate standard from return recycle samples than primary final effluent samples.

Table 2.2.3.1.30

## Comparison of $d_8$-Toluene Recovery
## (Primary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (1-FE) | d8 (RS) |
|---|---|---|
| Mean: | 95.089 | 100.064 |
| Std. Deviation: | 12.772 | 10.695 |
| Observations: | 36 | 213 |

| | | |
|---|---|---|
| t-statistic: | -2.507 | Hypothesis: |
| Degrees of Freedom: | 247 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.013 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_8$-toluene surrogate standard from raw sewage samples than primary final effluent samples.

Table 2.2.3.1.31

## Comparison of $d_8$-Toluene Recovery (Secondary Final Effluent/Primary Final Effluent)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (2-FE) | d8 (1-FE) |
|---|---|---|
| Mean: | 94.491 | 95.089 |
| Std. Deviation: | 11.891 | 12.772 |
| Observations: | 224 | 36 |

| | | |
|---|---|---|
| t-statistic: | -0.277 | Hypothesis: |
| Degrees of Freedom: | 258 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.782 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $d_8$-toluene surrogate recovery between primary and secondary final effluent samples.

Table 2.2.3.1.32

## Comparison of $d_8$-Toluene Recovery
## (Secondary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (2-FE) | d8 (RS) |
|---|---|---|
| Mean: | 94.491 | 100.064 |
| Std. Deviation: | 11.891 | 10.695 |
| Observations: | 224 | 213 |

| | | |
|---|---|---|
| t-statistic: | -5.143 | Hypothesis: |
| Degrees of Freedom: | 435 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.000 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_8$-toluene surrogate standard from raw sewage samples than secondary final effluent samples.

Table 2.2.3.1.33

## Comparison of $d_8$-Toluene Recovery (Secondary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (2-FE) | d8 (SL) |
|---|---|---|
| Mean: | 94.491 | 102.948 |
| Std. Deviation: | 11.891 | 10.514 |
| Observations: | 224 | 90 |

| | | |
|---|---|---|
| t-statistic: | -5.885 | Hypothesis: |
| Degrees of Freedom: | 312 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.000 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_8$-toluene surrogate standard from sludge samples than secondary final effluent samples.

Table 2.2.3.1.34

## Comparison of $d_8$-Toluene Recovery
## (Return Recycle/Secondary Final Effluent)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (2-FE) | d8 (RR) |
|---|---|---|
| Mean: | 94.491 | 100.217 |
| Std. Deviation: | 11.891 | 11.553 |
| Observations: | 224 | 42 |

| | | |
|---|---|---|
| t-statistic: | -2.876 | Hypothesis: |
| Degrees of Freedom: | 264 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.004 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.01$) recovery of $d_8$-toluene surrogate standard from return recycle samples than secondary final effluent samples.

Table 2.2.3.1.35

## Comparison of $d_8$-Toluene Recovery (Return Recycle/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (RR) | d8 (SL) |
|---|---|---|
| Mean: | 100.217 | 102.948 |
| Std. Deviation: | 11.553 | 10.514 |
| Observations: | 42 | 90 |

| | | |
|---|---|---|
| t-statistic: | -1.347 | Hypothesis: |
| Degrees of Freedom: | 130 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.180 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $d_8$-toluene surrogate recovery between return recycle and sludge samples.

Table 2.2.3.1.36

**Comparison of $d_8$-Toluene Recovery**
**(Raw Sewage/Return Recycle)**

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (RS) | d8 (RR) |
|---|---|---|
| Mean: | 100.064 | 100.217 |
| Std. Deviation: | 10.695 | 11.553 |
| Observations: | 213 | 42 |

| | | |
|---|---|---|
| t-statistic: | -0.083 | Hypothesis: |
| Degrees of Freedom: | 253 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.934 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $d_8$-toluene surrogate recovery between raw sewage and return recycle samples.

Table 2.2.3.1.37

## Comparison of $d_8$-Toluene Recovery
## (Raw Sewage/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | d8 (RS) | d8 (SL) |
|---|---|---|
| Mean: | 100.064 | 102.948 |
| Std. Deviation: | 10.695 | 10.514 |
| Observations: | 213 | 90 |

| | | |
|---|---|---|
| t-statistic: | -2.155 | Hypothesis: |
| Degrees of Freedom: | 301 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.032 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of $d_8$-toluene surrogate standard from sludge samples than raw sewage samples.

Table 2.2.3.1.38

## Comparison of Bromofluorobenzene Recovery
## (Primary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB (1-FE) | BFB(RR) |
|---|---|---|
| Mean: | 92.261 | 98.930 |
| Std. Deviation: | 14.675 | 17.419 |
| Observations: | 33 | 37 |

| | | |
|---|---|---|
| t-statistic: | -1.721 | Hypothesis: |
| Degrees of Freedom: | 68 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.090 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher (P<0.05) recovery of bromofluorobenzene surrogate standard from return recycle samples than primary final effluent samples.

Table 2.2.3.1.39

## Comparison of Bromofluorobenzene Recovery
## (Primary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB (1-FE) | BFB(SL) |
|---|---|---|
| Mean: | 92.261 | 100.389 |
| Std. Deviation: | 14.675 | 17.575 |
| Observations: | 33 | 79 |

| | | |
|---|---|---|
| t-statistic: | -2.337 | Hypothesis: |
| Degrees of Freedom: | 110 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.021 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.05$) recovery of bromofluorobenzene surrogate standard from sludge samples than primary final effluent samples.

Table 2.2.3.1.40

## Comparison of Bromofluorobenzene Recovery (Primary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB (1-FE) | BFB(RS) |
|---|---|---|
| Mean: | 92.261 | 98.907 |
| Std. Deviation: | 14.675 | 16.714 |
| Observations: | 33 | 195 |

| | | |
|---|---|---|
| t-statistic: | -2.148 | Hypothesis: |
| Degrees of Freedom: | 226 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.033 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($P<0.1$) recovery of bromofluorobenzene surrogate standard from raw sewage samples than primary final effluent samples.

Table 2.2.3.1.41

**Comparison of Bromofluorobenzene Recovery (Primary Final Effluent/Secondary Final Effluent)**

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(2-FE) | BFB (1-FE) |
|---|---|---|
| Mean: | 96.663 | 92.261 |
| Std. Deviation: | 16.051 | 14.675 |
| Observations: | 207 | 33 |

| | | |
|---|---|---|
| t-statistic: | 1.480 | Hypothesis: |
| Degrees of Freedom: | 238 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.140 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between primary and secondary final effluent samples.

Table 2.2.3.1.42

## Comparison of Bromofluorobenzene Recovery
## (Secondary Final Effluent/Raw Sewage)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(2-FE) | BFB(RS) |
|---|---|---|
| Mean: | 96.663 | 98.907 |
| Std. Deviation: | 16.051 | 16.714 |
| Observations: | 207 | 195 |

| | | |
|---|---|---|
| t-statistic: | -1.373 | Hypothesis: |
| Degrees of Freedom: | 400 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.171 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between secondary final effluent and raw sewage samples.

Table 2.2.3.1.43

## Comparison of Bromofluorobenzene Recovery
## (Secondary Final Effluent/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(2-FE) | BFB(SL) |
|---|---|---|
| Mean: | 96.663 | 100.389 |
| Std. Deviation: | 16.051 | 17.575 |
| Observations: | 207 | 79 |

| | | |
|---|---|---|
| t-statistic: | -1.709 | Hypothesis: |
| Degrees of Freedom: | 284 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.089 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher (P<0.10) recovery of bromofluorobenzene surrogate standard from sludge samples than secondary final effluent samples.

Table 2.2.3.1.44

## Comparison of Bromofluorobenzene Recovery (Secondary Final Effluent/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(2-FE) | BFB(RR) |
|---|---|---|
| Mean: | 96.663 | 98.930 |
| Std. Deviation: | 16.051 | 17.419 |
| Observations: | 207 | 37 |

| | | |
|---|---|---|
| t-statistic: | -0.781 | Hypothesis: |
| Degrees of Freedom: | 242 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.436 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between secondary final effluent and return recycle samples.

Table 2.2.3.1.45

## Comparison of Bromofluorobenzene Recovery (Return Recycle/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(RR) | BFB(SL) |
|---|---|---|
| Mean: | 98.930 | 100.389 |
| Std. Deviation: | 17.419 | 17.575 |
| Observations: | 37 | 79 |

| | | |
|---|---|---|
| t-statistic: | -0.418 | Hypothesis: |
| Degrees of Freedom: | 114 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.677 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between return recycle and sludge samples.

Table 2.2.3.1.46

## Comparison of Bromofluorobenzene Recovery (Raw Sewage/Return Recycle)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(RS) | BFB(RR) |
|---|---|---|
| Mean: | 98.907 | 98.930 |
| Std. Deviation: | 16.714 | 17.419 |
| Observations: | 195 | 37 |

| | | |
|---|---|---|
| t-statistic: | -0.008 | Hypothesis: |
| Degrees of Freedom: | 230 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.994 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between raw sewage and return recycle samples.

Table 2.2.3.1.47

## Comparison of Bromofluorobenzene Recovery
## (Raw Sewage/Sludge)

Data File: STT-VOA-04-MOE-STP

Independent Samples...

| Variable: | BFB(RS) | BFB(SL) |
|---|---|---|
| Mean: | 98.907 | 100.389 |
| Std. Deviation: | 16.714 | 17.575 |
| Observations: | 195 | 79 |

| | | |
|---|---|---|
| t-statistic: | -0.655 | Hypothesis: |
| Degrees of Freedom: | 272 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.513 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of bromofluorobenzene surrogate recovery between raw sewage and sludge samples.

Table 2.2.3.1.48

ZENON ENVIRONMENTAL INC.

## VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.17,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC Action Limits Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0.00 | 0.00 | 0 | | 40-100% |
| Dichlorodifluoromethane | 86 | 0.00 | 0.00 | 0 | | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0 | | 40-100% |
| Vinyl bromide | 106 | 0.00 | 0.00 | 0 | | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0 | | 60-120% |
| Diethyl ether | 74 | 0.00 | 0.00 | 0 | | 40-100% |
| Trichlorofluoromethane | 101 | 0.00 | 0.00 | 0 | | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 181 | 90% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 154 | 77% | 60-120% |
| 1,1-Dichloroethene * | 96 | 200.00 | 0.00 | 64 | 32% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0 | | 40-100% |
| Methylene chloride * | 84 | 200.00 | 0.00 | 242 | 121% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0 | | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 200.00 | 0.00 | 101 | 50% | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 128 | 64% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 168 | 84% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 155 | 77% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 144 | 72% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 152 | 76% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 128 | 64% | 60-120% |
| Benzene * | 78 | 200.00 | 0.00 | 110 | 55% | 60-120% |
| 1,2-Dichloropropane | 63 | 200.00 | 0.00 | 153 | 76% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 142 | 71% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 159 | 79% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 148 | 74% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 196 | 98% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 166 | 83% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 232 | 116% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 172 | 86% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 191 | 96% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 212 | 106% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 156 | 78% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 179 | 90% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 196 | 98% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 196 | 98% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0.00 | 0.00 | 0 | | 40-120% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Bromoform | 173 | 200.00 | 0.00 | 202 | 101% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 161 | 81% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 189 | 95% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 184 | 92% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 168 | 84% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 172 | 86% | 60-120% |
| Bromodichlorobenzene | 224 | 0.00 | 0.00 | 0 | | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.1

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.25,1987 |
| Matrix Type | water blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 415 | 208% | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 163 | 82% | 60-120% |
| Vinyl Chloride | 62 | 0 | 0 | 0 | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 193 | 96% | 40-100% |
| Chloroethane | 64 | 0 | 0 | 0 | | 60-120% |
| Diethyl ether | 74 | 200 | 0 | 241 | 120% | 40-100% |
| Trichlorofluoromethane * | 101 | 200 | 0 | 271 | 135% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 217 | 108% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 214 | 107% | 60-120% |
| 1,1-Dichloroethene * | 96 | 200 | 0 | 252 | 126% | 60-120% |
| Acrolein | 55/56 | 0 | 0 | 0 | | 40-100% |
| Acrylonitrile | 51/52 | 0 | 0 | 0 | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 183 | 91% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 0 | 0 | 0 | | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 200 | 0 | 278 | 139% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 239 | 119% | 60-120% |
| Hexane | 43/56/57 | 200 | 0 | 232 | 116% | 60-120% |
| Chloroform | 83 | 200 | 0 | 198 | 99% | 60-120% |
| 1,1,1-Trichloroethane * | 97 | 200 | 0 | 267 | 134% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 198 | 99% | 60-120% |
| Carbon tetrachloride * | 117 | 200 | 0 | 245 | 122% | 60-120% |
| Benzene | 78 | 200 | 0 | 196 | 98% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 165 | 83% | 60-120% |
| Trichloroethene * | 130 | 200 | 0 | 250 | 125% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 192 | 96% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200 | 0 | 157 | 79% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 195 | 97% | 60-120% |
| Toluene | 92 | 200 | 0 | 195 | 98% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 185 | 93% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200 | 0 | 143 | 72% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 224 | 112% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 161 | 81% | 60-120% |
| Tetrachloroethene | 164 | 200 | 0 | 227 | 113% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 205 | 103% | 60-120% |
| Ethylbenzene | 106 | 200 | 0 | 226 | 113% | 60-120% |
| Styrene | 90/104 | 0 | 0 | 0 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzen | 106 | 200 | 0 | 228 | 114% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0 | 0 | 0 | | 40-120% |
| Hexanol | 55/56 | 0 | 0 | 0 | | 40-100% |
| Bromoform | 173 | 200 | 0 | 188 | 94% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 147 | 73% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 209 | 104% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0 | 0 | 0 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 262 | 131% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 196 | 98% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 165 | 82% | 60-120% |
| Bromodichlorobenzene | 224 | 0 | 0 | 0 | | 60-120% |

* ouside the QA/QC action limits

Table 2.2.3.2.2

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.26,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200.00 | 0.00 | 75.00 | 38% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200.00 | 0.00 | 63.94 | 32% | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Vinyl bromide | 106 | 200.00 | 0.00 | 105.88 | 53% | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Diethyl ether | 74 | 200.00 | 0.00 | 165.77 | 83% | 40-100% |
| Trichlorofluoromethane | 101 | 200.00 | 0.00 | 133.56 | 67% | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 149.39 | 75% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 155.84 | 78% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 214.97 | 107% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 206.77 | 103% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 222.51 | 111% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | | | 60-120% |
| 1,1-Dichloroethane * | 63 | 200.00 | 0.00 | 307.21 | 154% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 215.96 | 108% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 224.51 | 112% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 202.02 | 101% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 184.34 | 92% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 222.96 | 111% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 226.95 | 113% | 60-120% |
| 1,2-Dichloropropane * | 63 | 200.00 | 0.00 | 217.78 | 109% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 213.92 | 107% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 229.58 | 115% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 212.93 | 106% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 225.91 | 113% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 193.87 | 97% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 221.25 | 111% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 167.74 | 84% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 126.16 | 63% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 200.00 | 100% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 213.61 | 107% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 203.77 | 102% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 161.90 | 81% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 163.10 | 82% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 200.00 | 0.00 | 161.90 | 81% | 40-100% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Bromoform | 173 | 200.00 | 0.00 | 183.82 | 92% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 182.91 | 91% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 172.46 | 86% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 228.16 | 114% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 240.00 | 120% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 217.70 | 109% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.3

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.27,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200.00 | 0.00 | 312 | 156% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200.00 | 0.00 | 67 | 33% | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0 | | 40-100% |
| Vinyl bromide | 106 | 200.00 | 0.00 | 108 | 54% | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0 | | 60-120% |
| Diethyl ether | 74 | 200.00 | 0.00 | 147 | 74% | 40-100% |
| Trichlorofluoromethane | 101 | 0.00 | 0.00 | 0 | | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 124 | 62% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 139 | 70% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 140 | 70% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 99 | 49% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 176 | 88% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 186 | 93% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 181 | 90% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 179 | 89% | 60-120% |
| 1,1,1-Trichloroethane * | 97 | 200.00 | 0.00 | 112 | 56% | 60-120% |
| 1,2-Dichloroethane * | 62 | 200.00 | 0.00 | 119 | 59% | 60-120% |
| Carbon tetrachloride * | 117 | 200.00 | 0.00 | 118 | 59% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 152 | 76% | 60-120% |
| 1,2-Dichloropropane | 63 | 200.00 | 0.00 | 167 | 84% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 149 | 75% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 134 | 67% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 160 | 80% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 151 | 75% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 157 | 79% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 213 | 106% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 236 | 118% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 178 | 89% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 140 | 70% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 154 | 77% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 132 | 66% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 182 | 91% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 164 | 82% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0.00 | 0.00 | 0 | | 40-120% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Bromoform | 173 | 200.00 | 0.00 | 115 | 58% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 143 | 71% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 171 | 86% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 172 | 86% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 146 | 73% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 140 | 70% | 60-120% |
| Bromodichlorobenzene | 224 | 0.00 | 0.00 | 0 | | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.4

ZENON ENVIRONMENTAL INC.

# VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Feb.28,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 200.00 | 0.00 | 182 | 91% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200.00 | 0.00 | 91 | 46% | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0 | | 40-100% |
| Vinyl bromide | 106 | 0.00 | 0.00 | 0 | | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0 | | 60-120% |
| Diethyl ether | 74 | 200.00 | 0.00 | 137 | 69% | 40-100% |
| Trichlorofluoromethane | 101 | 0.00 | 0.00 | 0 | | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 146 | 73% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 182 | 91% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 176 | 88% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 137 | 68% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 154 | 77% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 192 | 96% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 188 | 94% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 189 | 94% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 144 | 72% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 141 | 70% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 146 | 73% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 146 | 73% | 60-120% |
| 1,2-Dichloropropane | 63 | 200.00 | 0.00 | 212 | 106% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 150 | 75% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 188 | 94% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 231 | 115% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 176 | 88% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 147 | 74% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 147 | 73% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 204 | 102% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 170 | 85% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 231 | 115% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 151 | 76% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 154 | 77% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 210 | 105% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzen | 106 | 200.00 | 0.00 | 175 | 88% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0.00 | 0.00 | 0 | | 40-120% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Bromoform | 173 | 200.00 | 0.00 | 134 | 67% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 146 | 73% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 183 | 92% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 206 | 103% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 170 | 85% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 156 | 78% | 60-120% |
| Bromodichlorobenzene | 224 | 0.00 | 0.00 | 0 | | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.5

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Mar. 2,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0.00 | 0.00 | 0 | | 40-100% |
| Dichlorodifluoromethane | 86 | 0.00 | 0.00 | 0 | | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0 | | 40-100% |
| Vinyl bromide | 106 | 0.00 | 0.00 | 0 | | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0 | | 60-120% |
| Diethyl ether | 74 | 0.00 | 0.00 | 0 | | 40-100% |
| Trichlorofluoromethane | 101 | 0.00 | 0.00 | 0 | | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 128 | 64% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 189 | 95% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 150 | 75% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 147 | 74% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 167 | 84% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 217 | 108% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 153 | 76% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 178 | 89% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 169 | 85% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 132 | 66% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 147 | 74% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 142 | 71% | 60-120% |
| 1,2-Dichloropropane * | 63 | 200.00 | 0.00 | 100 | 50% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 168 | 84% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 195 | 97% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 0.00 | 0.00 | 0 | | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 173 | 86% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 233 | 117% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 210 | 105% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 135 | 68% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 235 | 118% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 215 | 108% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 150 | 75% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 164 | 82% | 60-120% |
| Styrene | 90/104 | 200.00 | 0.00 | 179 | 89% | 60-120% |
| 1,3-Dimethyl-benzene | 106 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 168 | 84% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0.00 | 0.00 | 0 | | 40-120% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0 | | 40-100% |
| Bromoform | 173 | 200.00 | 0.00 | 128 | 64% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 127 | 63% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 147 | 73% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 138 | 69% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 164 | 82% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 138 | 69% | 60-120% |
| Bromodichlorobenzene | 224 | 0.00 | 0.00 | 0 | | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.6

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TC

Instrument GC/MS Analysis Date Mar.5,1987

Matrix Type Water Blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 200.00 | 0.00 | 111.88 | 56% | 40-100% |
| Dichlorodifluoromethane | 86 | 200.00 | 0.00 | 191.78 | 96% | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Vinyl bromide | 106 | 200.00 | 0.00 | 102.04 | 51% | 40-100% |
| Chloroethane | 64 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Diethyl ether * | 74 | 200.00 | 0.00 | 270.35 | 135% | 40-100% |
| Trichlorofluoromethane | 101 | 200.00 | 0.00 | 125.76 | 63% | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 153.43 | 77% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 151.86 | 76% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 118.00 | 59% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 135.10 | 68% | 60-120% |
| cis-1,2-Dichloroethene * | 61 | 200.00 | 0.00 | 98.47 | 49% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 130.00 | 65% | 60-120% |
| Hexane * | 43/56/57 | 200.00 | 0.00 | 302.44 | 151% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 133.75 | 67% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 140.19 | 70% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 138.20 | 69% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 139.90 | 70% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 128.95 | 64% | 60-120% |
| 1,2-Dichloropropane | 63 | 200.00 | 0.00 | 219.38 | 110% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 169.05 | 85% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 186.67 | 93% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 168.42 | 84% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 177.50 | 89% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 169.53 | 85% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 146.00 | 73% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 153.85 | 77% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 147.59 | 74% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 204.17 | 102% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 159.88 | 80% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 155.75 | 78% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 209.30 | 105% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 167.44 | 84% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 200.00 | 0.00 | 207.69 | 104% | 40-100% |
| Hexanol | 55/56 | 200.00 | 0.00 | 131.65 | 66% | 60-120% |
| Bromoform | 173 | 200.00 | 0.00 | 145.05 | 73% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200.00 | 0.00 | 151.39 | 76% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 160.66 | 80% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200.00 | 0.00 | 228.57 | 114% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200.00 | 0.00 | 208.33 | 104% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 149.19 | 75% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.7

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Mar.9,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Dichlorodifluoromethane | 86 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Vinyl bromide | 106 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Chloroethane | 64 | 200.00 | 0.00 | 209.00 | 105% | 60-120% |
| Diethyl ether | 74 | 200.00 | 0.00 | 212.91 | 106% | 40-100% |
| Trichlorofluoromethane | 101 | 200.00 | 0.00 | 126.13 | 63% | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 194.96 | 97% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 171.62 | 86% | 60-120% |
| 1,1-Dichloroethene * | 96 | 200.00 | 0.00 | 109.92 | 55% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 230.00 | 115% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 126.16 | 63% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,1-Dichloroethane * | 63 | 200.00 | 0.00 | 91.25 | 46% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 166.35 | 83% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 160.00 | 80% | 60-120% |
| 1,1,1-Trichloroethane * | 97 | 200.00 | 0.00 | 85.61 | 43% | 60-120% |
| 1,2-Dichloroethane * | 62 | 200.00 | 0.00 | 88.67 | 44% | 60-120% |
| Carbon tetrachloride * | 117 | 200.00 | 0.00 | 100.55 | 50% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 125.24 | 63% | 60-120% |
| 1,2-Dichloropropane * | 63 | 200.00 | 0.00 | 84.75 | 42% | 60-120% |
| Trichloroethene * | 130 | 200.00 | 0.00 | 30.46 | 15% | 60-120% |
| Bromodichloromethane * | 83 | 200.00 | 0.00 | 86.11 | 43% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200.00 | 0.00 | 153.02 | 77% | 60-120% |
| cis-1,3-Dichloropropene * | 75 | 200.00 | 0.00 | 71.26 | 36% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 95.34 | 48% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,1,2-Trichloroethane * | 97 | 200.00 | 0.00 | 74.03 | 37% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 158.25 | 79% | 60-120% |
| Dibromochloromethane * | 129 | 200.00 | 0.00 | 89.34 | 45% | 60-120% |
| Tetrachloroethene * | 164 | 200.00 | 0.00 | 86.88 | 43% | 60-120% |
| Chlorobenzene * | 112 | 200.00 | 0.00 | 82.38 | 41% | 60-120% |
| Ethylbenzene * | 106 | 200.00 | 0.00 | 93.00 | 47% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 185.71 | 93% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 200.00 | 0.00 | 100.00 | 50% | 40-100% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Bromoform * | 173 | 200.00 | 0.00 | 100.00 | 50% | 60-120% |
| 1,1,2,2-Tetrachloroethane * | 83 | 200.00 | 0.00 | 82.93 | 41% | 60-120% |
| Benzyl chloride | 91/126 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3-Dichlorobenzene * | 146 | 200.00 | 0.00 | 62.50 | 31% | 60-120% |
| 1,4-Dichlorobenzene * | 146 | 200.00 | 0.00 | 62.50 | 31% | 60-120% |
| 1,2-Dichlorobenzene * | 146 | 200.00 | 0.00 | 66.09 | 33% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.8

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | Mar.10,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Dichlorodifluoromethane | 86 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Vinyl Chloride | 62 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Vinyl bromide | 106 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Chloroethane * | 64 | 200.00 | 0.00 | 256.00 | 128% | 60-120% |
| Diethyl ether * | 74 | 200.00 | 0.00 | 298.53 | 149% | 40-100% |
| Trichlorofluoromethane * | 101 | 200.00 | 0.00 | 265.00 | 133% | 60-120% |
| Bromoethane | 108 | 200.00 | 0.00 | 163.33 | 82% | 60-120% |
| 3-Chloro-1-propene | 76 | 200.00 | 0.00 | 189.00 | 95% | 60-120% |
| 1,1-Dichloroethene | 96 | 200.00 | 0.00 | 200.96 | 100% | 60-120% |
| Acrolein | 55/56 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Acrylonitrile | 51/52 | 0.00 | 0.00 | 0.00 | | 40-100% |
| Methylene chloride | 84 | 200.00 | 0.00 | 210.95 | 105% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200.00 | 0.00 | 214.20 | 107% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,1-Dichloroethane | 63 | 200.00 | 0.00 | 202.68 | 101% | 60-120% |
| Hexane | 43/56/57 | 200.00 | 0.00 | 141.02 | 71% | 60-120% |
| Chloroform | 83 | 200.00 | 0.00 | 129.31 | 65% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200.00 | 0.00 | 204.17 | 102% | 60-120% |
| 1,2-Dichloroethane | 62 | 200.00 | 0.00 | 208.56 | 104% | 60-120% |
| Carbon tetrachloride | 117 | 200.00 | 0.00 | 201.35 | 101% | 60-120% |
| Benzene | 78 | 200.00 | 0.00 | 127.56 | 64% | 60-120% |
| 1,2-Dichloropropane | 63 | 200.00 | 0.00 | 138.75 | 69% | 60-120% |
| Trichloroethene | 130 | 200.00 | 0.00 | 171.36 | 86% | 60-120% |
| Bromodichloromethane | 83 | 200.00 | 0.00 | 196.72 | 98% | 60-120% |
| 2-Chloroethylvinyl ether * | 63 | 200.00 | 0.00 | 249.12 | 125% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200.00 | 0.00 | 186.82 | 93% | 60-120% |
| Toluene | 92 | 200.00 | 0.00 | 167.16 | 84% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,1,2-Trichloroethane | 97 | 200.00 | 0.00 | 215.56 | 108% | 60-120% |
| 1-Octene | 70/56 | 200.00 | 0.00 | 173.14 | 87% | 60-120% |
| Dibromochloromethane | 129 | 200.00 | 0.00 | 201.96 | 101% | 60-120% |
| Tetrachloroethene | 164 | 200.00 | 0.00 | 190.74 | 95% | 60-120% |
| Chlorobenzene | 112 | 200.00 | 0.00 | 186.34 | 93% | 60-120% |
| Ethylbenzene | 106 | 200.00 | 0.00 | 213.73 | 107% | 60-120% |
| Styrene | 90/104 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200.00 | 0.00 | 170.99 | 85% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 200.00 | 0.00 | 210.00 | 105% | 40-100% |
| Hexanol | 55/56 | 0.00 | 0.00 | 0.00 | | 60-120% |
| Bromoform | 173 | 200.00 | 0.00 | 235.82 | 118% | 60-120% |
| 1,1,2,2-Tetrachloroethane * | 83 | 200.00 | 0.00 | 250.00 | 125% | 60-120% |
| Benzyl chloride | 91/126 | 200.00 | 0.00 | 173.20 | 87% | 60-120% |
| 3-Chloro-toluene | 91/126 | 0.00 | 0.00 | 0.00 | | 60-120% |
| 1,3-Dichlorobenzene * | 146 | 200.00 | 0.00 | 282.26 | 141% | 60-120% |
| 1,4-Dichlorobenzene * | 146 | 200.00 | 0.00 | 291.67 | 146% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200.00 | 0.00 | 250.00 | 125% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.9

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | 18-Mar-87 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 76.1 | 38% | 40-100% |
| Dichlorodifluoromethane | 86 | 0 | 0 | 0.0 | | 60-120% |
| Vinyl Chloride | 62 | 200 | 0 | 147.3 | 74% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 105.5 | 53% | 40-100% |
| Chloroethane | 64 | 200 | 0 | 161.3 | 81% | 60-120% |
| Diethyl ether | 74 | 200 | 0 | 147.7 | 74% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 147.6 | 74% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 160.0 | 80% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 148.6 | 74% | 60-120% |
| 1,1-Dichloroethene | 96 | 200 | 0 | 154.3 | 77% | 60-120% |
| Acrolein | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Acrylonitrile | 51/52 | 0 | 0 | 0.0 | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 105.2 | 53% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 167.4 | 84% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 197.9 | 99% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 174.2 | 87% | 60-120% |
| Hexane * | 43/56/57 | 200 | 0 | 75.7 | 38% | 60-120% |
| Chloroform | 83 | 200 | 0 | 128.9 | 64% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 151.3 | 76% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 165.3 | 83% | 60-120% |
| Carbon tetrachloride | 117 | 0 | 0 | 0.0 | | 60-120% |
| Benzene | 78 | 0 | 0 | 0.0 | | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 152.8 | 76% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 139.4 | 70% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 119.8 | 60% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 200 | 0 | 122.1 | 61% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 162.6 | 81% | 60-120% |
| Toluene | 92 | 200 | 0 | 139.4 | 70% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 167.9 | 84% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 0 | 0 | 0.0 | | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 160.0 | 80% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 145.6 | 73% | 60-120% |
| Tetrachloroethene | 164 | 200 | 0 | 170.0 | 85% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 162.8 | 81% | 60-120% |
| Ethylbenzene | 106 | 200 | 0 | 154.3 | 77% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 150.8 | 75% | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 200 | 0 | 205.3 | 103% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0 | 0 | 0.0 | | 40-120% |
| Hexanol | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Bromoform | 173 | 200 | 0 | 171.9 | 86% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 169.5 | 85% | 60-120% |
| Benzyl chloride | 91/126 | 0 | 0 | 0.0 | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 160.4 | 80% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 166.9 | 83% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 148.5 | 74% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 157.6 | 79% | 60-120% |
| Bromodichlorobenzene | 224 | 200 | 0 | 220.3 | 110% | 60-120% |

* ouside the QA/QC action limits

Table 2.2.3.2.10

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | 24-Mar-87 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0 | 0 | 0.0 | | 40-100% |
| Dichlorodifluoromethane | 86 | 400 | 0 | 363.6 | 91% | 60-120% |
| Vinyl Chloride* | 62 | 400 | 0 | 794.2 | 199% | 40-100% |
| Vinyl bromide | 106 | 400 | 0 | 310.0 | 78% | 40-100% |
| Chloroethane | 64 | 400 | 0 | 381.8 | 95% | 60-120% |
| Diethyl ether | 74 | 400 | 0 | 271.3 | 68% | 40-100% |
| Trichlorofluoromethane | 101 | 400 | 0 | 278.4 | 70% | 60-120% |
| Bromoethane | 108 | 0 | 0 | 0.0 | | 60-120% |
| 3-Chloro-1-propene * | 76 | 400 | 0 | 990.0 | 248% | 60-120% |
| 1,1-Dichloroethene | 96 | 400 | 0 | 249.6 | 62% | 60-120% |
| Acrolein | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Acrylonitrile | 51/52 | 0 | 0 | 0.0 | | 40-100% |
| Methylene chloride | 84 | 400 | 0 | 295.1 | 74% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 400 | 0 | 295.7 | 74% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 0 | 0 | 0.0 | | 60-120% |
| 1,1-Dichloroethane | 63 | 400 | 0 | 293.4 | 73% | 60-120% |
| Hexane * | 43/56/57 | 400 | 0 | 222.5 | 56% | 60-120% |
| Chloroform | 83 | 400 | 0 | 334.1 | 84% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 400 | 0 | 298.8 | 75% | 60-120% |
| 1,2-Dichloroethane* | 62 | 400 | 0 | 88.5 | 22% | 60-120% |
| Carbon tetrachloride * | 117 | 400 | 0 | 120.0 | 30% | 60-120% |
| Benzene * | 78 | 400 | 0 | 180.0 | 45% | 60-120% |
| 1,2-Dichloropropane | 63 | 400 | 0 | 287.9 | 72% | 60-120% |
| Trichloroethene | 130 | 400 | 0 | 254.1 | 64% | 60-120% |
| Bromodichloromethane | 83 | 400 | 0 | 314.9 | 79% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 400 | 0 | 313.0 | 78% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 400 | 0 | 265.7 | 66% | 60-120% |
| Toluene | 92 | 400 | 0 | 325.7 | 81% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 400 | 0 | 280.9 | 70% | 60-120% |
| 1,1,2-Trichloroethane | 97 | 400 | 0 | 306.6 | 77% | 60-120% |
| 1-Octene * | 70/56 | 400 | 0 | 610.9 | 153% | 60-120% |
| Dibromochloromethane * | 129 | 400 | 0 | 168.4 | 42% | 60-120% |
| Tetrachloroethene | 164 | 400 | 0 | 268.3 | 67% | 60-120% |
| Chlorobenzene | 112 | 400 | 0 | 334.4 | 84% | 60-120% |
| Ethylbenzene | 106 | 400 | 0 | 280.3 | 70% | 60-120% |
| Styrene | 90/104 | 400 | 0 | 349.5 | 87% | 60-120% |
| 1,3 & 1,4-Dimethyl-benzene | 106 | 400 | 0 | 363.7 | 91% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 0 | 0 | 0.0 | | 40-120% |
| Hexanol | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Bromoform | 173 | 400 | 0 | 257.7 | 64% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 400 | 0 | 254.2 | 64% | 60-120% |
| Benzyl chloride | 91/126 | 0 | 0 | 0.0 | | 60-120% |
| 3-Chloro-toluene | 91/126 | 400 | 0 | 375.0 | 94% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 0 | 0 | 0.0 | | 60-120% |
| 1,4-Dichlorobenzene | 146 | 0 | 0 | 0.0 | | 60-120% |
| 1,2-Dichlorobenzene | 146 | 0 | 0 | 0.0 | | 60-120% |
| Bromodichlorobenzene | 224 | 0 | 0 | 0.0 | | 60-120% |

* ouside the QA/QC action limits

Table 2.2.3.2.11

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TC

Instrument GC/MS Analysis Date 15-Apr-87

Matrix Type Water Blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC Action Limits Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 0 | 0 | 0.0 | | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 114.3 | 57% | 60-120% |
| Vinyl Chloride | 62 | 0 | 0 | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 184.6 | 92% | 40-100% |
| Chloroethane* | 64 | 200 | 0 | 285.4 | 143% | 60-120% |
| Diethyl ether | 74 | 200 | 0 | 150.5 | 75% | 40-100% |
| Trichlorofluoromethane | 101 | 0 | 0 | 0.0 | | 60-120% |
| Bromoethane | 108 | 200 | 0 | 180.4 | 90% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 160.0 | 80% | 60-120% |
| 1,1-Dichloroethene * | 96 | 200 | 0 | 86.8 | 43% | 60-120% |
| Acrolein | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Acrylonitrile | 51/52 | 0 | 0 | 0.0 | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 51.6 | 26% | 60-120% |
| cis-1,2-Dichloroethene * | 61 | 200 | 0 | 250.3 | 125% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 166.0 | 83% | 60-120% |
| 1,1-Dichloroethane * | 63 | 200 | 0 | 82.3 | 41% | 60-120% |
| Hexane * | 43/56/57 | 200 | 0 | 95.3 | 48% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 111.2 | 56% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 191.7 | 96% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 240.3 | 120% | 60-120% |
| Carbon tetrachloride * | 117 | 200 | 0 | 72.8 | 36% | 60-120% |
| Benzene | 78 | 200 | 0 | 148.5 | 74% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 143.6 | 72% | 60-120% |
| Trichloroethene * | 130 | 200 | 0 | 95.3 | 48% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 205.3 | 103% | 60-120% |
| 2-Chloroethylvinyl ether | 63 | 0 | 0 | 0.0 | | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 233.0 | 117% | 60-120% |
| Toluene | 92 | 200 | 0 | 161.7 | 81% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 289.9 | 145% | 60-120% |
| 1,1,2-Trichloroethane * | 97 | 200 | 0 | 329.2 | 165% | 60-120% |
| 1-Octene * | 70/56 | 200 | 0 | 99.6 | 50% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 127.4 | 64% | 60-120% |
| Tetrachloroethene | 164 | 200 | 0 | 125.0 | 63% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 152.3 | 76% | 60-120% |
| Ethylbenzene | 106 | 200 | 0 | 186.0 | 93% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 166.0 | 83% | 60-120% |
| 1,3 & 1,4-Dimethyl-benzen | 106 | 200 | 0 | 148.9 | 74% | 60-120% |
| 1,2-Dimethyl-benzene | 106 | 200 | 0 | 154.4 | 77% | 40-120% |
| Hexanol | 55/56 | 0 | 0 | 0.0 | | 40-100% |
| Bromoform | 173 | 200 | 0 | 211.7 | 106% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 80.0 | 40% | 60-120% |
| Benzyl chloride | 91/126 | 0 | 0 | 0.0 | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 139.1 | 70% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 122.3 | 61% | 60-120% |
| 1,4-Dichlorobenzene * | 146 | 200 | 0 | 111.1 | 56% | 60-120% |
| 1,2-Dichlorobenzene * | 146 | 200 | 0 | 117.3 | 59% | 60-120% |
| Bromodichlorobenzene * | 224 | 200 | 0 | 108.2 | 54% | 60-120% |

* ouside the QA/QC action limits

Table 2.2.3.2.12

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TC |
| Instrument | GC/MS | Analysis Date | May 11/87 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 80 | 0 | 41.3 | 52% | 40-100% |
| Dichlorodifluoromethane | 85 | 80 | 0 | 78.5 | 98% | 60-120% |
| Vinyl Chloride | 62 | 80 | 0 | 50.7 | 63% | 40-100% |
| Vinyl bromide* | 106 | 80 | 0 | 98.5 | 123% | 40-100% |
| Chloroethane * | 64 | 80 | 0 | 44.6 | 56% | 60-120% |
| Diethyl ether | 45 | 80 | 0 | 44.8 | 56% | 40-100% |
| Trichlorofluoromethane | 101 | 80 | 0 | 48.4 | 61% | 60-120% |
| Bromoethane * | 108 | 80 | 0 | 27.8 | 35% | 60-120% |
| 3-Chloro-1-propene * | 76 | 80 | 0 | 40.0 | 50% | 60-120% |
| 1,1- Dichloroethene | 61 | 80 | 0 | 70.6 | 88% | 60-120% |
| Acrolein | 55 | 0 | 0 | 0.0 | | 40-100% |
| Acrylonitrile | 53 | 0 | 0 | 0.0 | | 40-100% |
| Methylene chloride | 84 | 80 | 0 | 72.7 | 91% | 60-120% |
| cis-1,2-Dichloroethene * | 61 | 80 | 0 | 43.6 | 55% | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 80 | 0 | 33.0 | 41% | 60-120% |
| 1,1-Dichloroethane | 63 | 80 | 0 | 86.7 | 108% | 60-120% |
| Hexane | 56 | 80 | 0 | 48.1 | 60% | 60-120% |
| Chloroform | 83 | 80 | 0 | 51.0 | 64% | 60-120% |
| 1,1,1-Trichloroethane * | 97 | 80 | 0 | 20.3 | 25% | 60-120% |
| 1,2-Dichloroethane | 62 | 80 | 0 | 47.6 | 60% | 60-120% |
| Carbon Tetrachloride * | 117 | 80 | 0 | 29.1 | 36% | 60-120% |
| Benzene | 78 | 80 | 0 | 48.9 | 61% | 60-120% |
| 1,2-Dichloropropane | 63 | 80 | 0 | 53.6 | 67% | 60-120% |
| Trichloroethene | 130 | 80 | 0 | 49.8 | 62% | 60-120% |
| Dibromomethane * | 174 | 80 | 0 | 46.2 | 58% | 60-120% |
| bis(2-Chloroethylvinyl)ether | 63 | 0 | 0 | 0.0 | | 60-120% |
| Bromodichloromethane* | 83 | 80 | 0 | 47.1 | 59% | 60-120% |
| cis-1,3-Dichloropropene* | 75 | 80 | 0 | 46.8 | 59% | 60-120% |
| Toluene * | 91 | 80 | 0 | 45.5 | 57% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 80 | 0 | 54.3 | 68% | 60-120% |
| 1,2-Dibromoethane | 107 | 80 | 0 | 89.8 | 112% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 80 | 0 | 74.8 | 94% | 60-120% |
| 1-Octene | 70 | 80 | 0 | 91.1 | 114% | 60-120% |
| Dibromochloromethane* | 129 | 80 | 0 | 96.7 | 121% | 60-120% |
| Tetrachloroethene | 166 | 80 | 0 | 85.6 | 107% | 60-120% |
| Chlorobenzene | 112 | 80 | 0 | 49.1 | 61% | 60-120% |
| Ethylbenzene * | 91 | 80 | 0 | 47.5 | 59% | 60-120% |
| Styrene | 104 | 80 | 0 | 48.5 | 61% | 60-120% |
| 1,2&1,3 Xylene | 91 | 80 | 0 | 48.5 | 61% | 40-100% |
| 1,4-Dimethyl benzene * | 91 | 80 | 0 | 47.5 | 59% | 60-120% |
| Hexanol | 56 | 0 | 0 | 0.0 | | 40-120% |
| Bromoform | 173 | 80 | 0 | 54.4 | 68% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 80 | 0 | 54.7 | 68% | 60-120% |
| Benzyl chloride | 91 | 80 | 0 | 56.5 | 71% | 60-120% |
| 3-Chloro-toluene | 91 | 80 | 0 | 49.4 | 62% | 60-120% |
| 1,3-Dichlorobenzene* | 146 | 80 | 0 | 47.2 | 59% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 80 | 0 | 50.3 | 63% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 80 | 0 | 49.6 | 62% | 60-120% |
| Bromodichlorobenzene | 226 | 80 | 0 | 58.6 | 73% | 60-120% |

* ouside the QA/QC action limits

Table 2.2.3.2.13

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TMC

Instrument GC/MS Analysis Date May.12,1987

Matrix Type Water Blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | | | | | 40-100% |
| Dichlorodifluoromethane | 86 | | | | | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | | | | | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether | 45 | | | | | 40-100% |
| Trichlorofluoromethane | 101 | | | | | 60-120% |
| Bromoethane | 108 | | | | | 60-120% |
| 3-Chloro-1-propene | 76 | | | | | 60-120% |
| 1,1-Dichloroethene | 61 | | | | | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 285.2 | 143% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 249.3 | 125% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 222.9 | 111% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 216.5 | 108% | 60-120% |
| Hexane | 56 | 200 | 0 | 223.5 | 112% | 60-120% |
| Chloroform | 83 | 200 | 0 | 239.4 | 120% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 208.8 | 104% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 213.8 | 107% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 202.5 | 101% | 60-120% |
| Benzene * | 78 | 200 | 0 | 262.8 | 131% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 204.3 | 102% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 209.1 | 105% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 217.0 | 109% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 218.2 | 109% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 177.2 | 89% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 190.7 | 95% | 60-120% |
| Toluene | 91 | 200 | 0 | 204.3 | 102% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 177.3 | 89% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 216.2 | 108% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 212.5 | 106% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 201.7 | 101% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 190.5 | 95% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 189.2 | 95% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 196.1 | 98% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 188.6 | 94% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 196.3 | 98% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 194.9 | 97% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 191.6 | 96% | 60-120% |
| Hexanol * | 55/56 | 200 | 0 | 90.6 | 45% | 60-120% |
| Bromoform | 173 | 200 | 0 | 170.4 | 85% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 197.7 | 99% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 191.3 | 96% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 180.1 | 90% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 194.4 | 97% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 194.5 | 97% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 192.5 | 96% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.14

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | May.18,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 100.00 | 0.00 | 85.7 | 86% | 40-100% |
| Dichlorodifluoromethane * | 86 | 100.00 | 0.00 | 124.5 | 125% | 60-120% |
| Vinyl Chloride | 62 | 100.00 | 0.00 | 57.7 | 58% | 40-100% |
| Vinyl bromide | 106 | 100.00 | 0.00 | 86.2 | 86% | 40-100% |
| Chloroethane | 64 | 100.00 | 0.00 | 83.7 | 84% | 60-120% |
| Diethyl ether * | 45 | 100.00 | 0.00 | 127.4 | 127% | 40-100% |
| Trichlorofluoromethane | 101 | 100.00 | 0.00 | 89.2 | 89% | 60-120% |
| Bromoethane | 108 | 100.00 | 0.00 | 83.5 | 83% | 60-120% |
| 3-Chloro-1-propene | 76 | 100.00 | 0.00 | 79.2 | 79% | 60-120% |
| 1,1-Dichloroethene * | 61 | 100.00 | 0.00 | 113.9 | 114% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 100.00 | 0.00 | 181.9 | 182% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 100.00 | 0.00 | 89.6 | 90% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 100.00 | 0.00 | 82.8 | 83% | 60-120% |
| 1,1-Dichloroethane | 63 | 100.00 | 0.00 | 90.0 | 90% | 60-120% |
| Hexane * | 56 | 100.00 | 0.00 | 199.0 | 199% | 60-120% |
| Chloroform * | 83 | 100.00 | 0.00 | 184.4 | 184% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 100.00 | 0.00 | 90.0 | 90% | 60-120% |
| 1,2-Dichloroethane | 62 | 100.00 | 0.00 | 88.1 | 88% | 60-120% |
| Carbon tetrachloride | 117 | 100.00 | 0.00 | 67.9 | 68% | 60-120% |
| Benzene * | 78 | 100.00 | 0.00 | 182.8 | 183% | 60-120% |
| 1,2-Dichloropropane * | 63 | 100.00 | 0.00 | 123.6 | 124% | 60-120% |
| Trichloroethene | 130 | 100.00 | 0.00 | 96.5 | 97% | 60-120% |
| Dibromomethane | 174 | 100.00 | 0.00 | 96.5 | 96% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane | 83 | 100.00 | 0.00 | 112.7 | 113% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 100.00 | 0.00 | 73.2 | 73% | 60-120% |
| Toluene * | 91 | 100.00 | 0.00 | 173.3 | 173% | 60-120% |
| trans-1,3-Dichloropropene | 75 | | | | | 60-120% |
| 1,2-Dibromoethane | 107 | 100.00 | 0.00 | 61.2 | 61% | 60-120% |
| 1,1,2-Trichloroethane * | 83 | 100.00 | 0.00 | 56.6 | 57% | 60-120% |
| 1-Octene | 70/56 | 100.00 | 0.00 | 93.2 | 93% | 60-120% |
| Dibromochloromethane | 129 | 100.00 | 0.00 | 83.3 | 83% | 60-120% |
| Tetrachloroethene | 166 | 100.00 | 0.00 | 69.2 | 69% | 60-120% |
| Chlorobenzene | 112 | 100.00 | 0.00 | 94.6 | 95% | 60-120% |
| Ethylbenzene | 91 | 100.00 | 0.00 | 99.4 | 99% | 60-120% |
| Styrene | 90/104 | 100.00 | 0.00 | 80.0 | 80% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 100.00 | 0.00 | 108.4 | 108% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 100.00 | 0.00 | 108.3 | 108% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 100.00 | 0.00 | 80.9 | 81% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 100.00 | 0.00 | 77.6 | 78% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 100.00 | 0.00 | 88.2 | 88% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 100.00 | 0.00 | 78.8 | 79% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 100.00 | 0.00 | 90.9 | 101% | 60-120% |
| 1,2-Dichlorobenzene * | 146 | 100.00 | 0.00 | 81.7 | 35.5% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.15

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | May.19.1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | | | | | 40-100% |
| Dichlorodifluoromethane | 86 | | | | | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | | | | | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether | 45 | | | | | 40-100% |
| Trichlorofluoromethane | 101 | | | | | 60-120% |
| Bromoethane | 108 | | | | | 60-120% |
| 3-Chloro-1-propene | 76 | | | | | 60-120% |
| 1,1-Dichloroethene | 61 | | | | | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 336.5 | 168% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 193.6 | 97% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 200.0 | 100% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 207.7 | 104% | 60-120% |
| Hexane | 56 | 200 | 0 | 180.5 | 90% | 60-120% |
| Chloroform | 83 | 200 | 0 | 181.6 | 91% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 236.5 | 118% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 158.0 | 79% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 185.7 | 93% | 60-120% |
| Benzene | 78 | 200 | 0 | 231.7 | 116% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 217.7 | 109% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 202.4 | 101% | 60-120% |
| Dibromomethane | 174 | | | | | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 114.9 | 57% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 207.5 | 104% | 60-120% |
| Toluene | 91 | 200 | 0 | 206.2 | 103% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 226.4 | 113% | 60-120% |
| 1,2-Dibromoethane | 107 | | | | | 60-120% |
| 1,1,2-Trichloroethane * | 83 | 200 | 0 | 241.7 | 121% | 60-120% |
| 1-Octene | 70/56 | | | | | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 217.7 | 109% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 237.0 | 119% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 213.2 | 107% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 200.0 | 100% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 211.7 | 106% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 207.3 | 104% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 204.6 | 102% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 235.3 | 118% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 226.0 | 113% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 195.6 | 98% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 198.2 | 99% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 194.0 | 97% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 200.0 | 100% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 202.3 | 101% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.16

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | May.19,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 200 | 0 | 190.5 | 95% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 360.9 | 180% | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 143 | 72% | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether * | 45 | 200 | 0 | 255.9 | 128% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 193.2 | 97% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 145.5 | 73% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 133.3 | 67% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 231.1 | 116% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 255.0 | 128% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 185.2 | 93% | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 200 | 0 | 104.2 | 52% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 239.6 | 120% | 60-120% |
| Hexane * | 56 | 200 | 0 | 299.2 | 150% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 284.3 | 142% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 168.3 | 84% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 215.0 | 108% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 167.1 | 84% | 60-120% |
| Benzene * | 78 | 200 | 0 | 284.6 | 142% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 154.0 | 77% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 198.7 | 99% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 206.4 | 103% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 190.1 | 95% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 173.4 | 87% | 60-120% |
| Toluene | 91 | 200 | 0 | 226.3 | 113% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 190.2 | 95% | 60-120% |
| 1,2-Dibromoethane* | 107 | 200 | 0 | 117.6 | 59% | 60-120% |
| 1,1,2-Trichloroethane * | 83 | 200 | 0 | 90.7 | 45% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 176 | 88% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 167.3 | 84% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 190.1 | 95% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 179.6 | 90% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 195.4 | 98% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 169.7 | 85% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 195.3 | 98% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 196.3 | 98% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 206.9 | 103% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 195.4 | 98% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 180.3 | 90% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 184.3 | 92% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 199.4 | 100% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 197.5 | 99% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.17

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | June 2,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | | | | | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 95 | 48% | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 165.9 | 83% | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 217.3 | 109% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 178.6 | 89% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 156 | 78% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 34.8 | 17% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 233.8 | 117% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 232.1 | 116% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 194.8 | 97% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 160.7 | 80% | 60-120% |
| 1,1-Dichloroethane * | 63 | 200 | 0 | 242.5 | 121% | 60-120% |
| Hexane | 56 | 200 | 0 | 230.9 | 115% | 60-120% |
| Chloroform | 83 | 200 | 0 | 204.0 | 102% | 60-120% |
| 1,1,1-Trichloroethane * | 97 | 200 | 0 | 91.9 | 46% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 169.9 | 85% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 149.5 | 75% | 60-120% |
| Benzene * | 78 | 200 | 0 | 242.7 | 121% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 222.6 | 111% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 216.7 | 108% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 199 | 100% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 202.8 | 101% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 172.9 | 86% | 60-120% |
| Toluene * | 91 | 200 | 0 | 254.8 | 127% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 229.5 | 115% | 60-120% |
| 1,2-Dibromoethane* | 107 | 200 | 0 | 503.4 | 252% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 150.0 | 75% | 60-120% |
| 1-Octene * | 70/56 | 200 | 0 | 388.4 | 194% | 60-120% |
| Dibromochloromethane * | 129 | 200 | 0 | 253.7 | 127% | 60-120% |
| Tetrachloroethene * | 166 | 200 | 0 | 248.5 | 124% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 210.3 | 105% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 215.1 | 108% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 211.5 | 106% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 221.2 | 111% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 229.7 | 115% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 152.6 | 76% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 187.9 | 94% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 210.8 | 105% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 187.7 | 94% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 194.9 | 97% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 169.4 | 85% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.18

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | June 10,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane* | 50 | 200 | 0 | 293.9 | 147% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 90.3 | 45% | 60-120% |
| Vinyl Chloride * | 62 | 200 | 0 | 115.8 | 58% | 40-100% |
| Vinyl bromide * | 106 | 200 | 0 | 76.9 | 38% | 40-100% |
| Chloroethane | 64 | 200 | 0 | 133 | 67% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 149 | 75% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 133 | 67% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 228 | 114% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 139.3 | 70% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 144.2 | 72% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 359.6 | 180% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 177.1 | 89% | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 200 | 0 | 251.6 | 126% | 60-120% |
| 1,1-Dichloroethane * # | 63 | 200 | 0 | 323.6 | 162% | 60-120% |
| Hexane * | 56 | 200 | 0 | 450.9 | 225% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 274.1 | 137% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 177.7 | 89% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 170.8 | 85% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 205.8 | 103% | 60-120% |
| Benzene | 78 | 200 | 0 | 237.8 | 119% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 222.5 | 111% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 168.1 | 84% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 191.9 | 96% | 60-120% |
| bis(2-Chloroethylvinyl) ether* | 63 | 200 | 0 | 92.4 | 46% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 224.6 | 112% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 166.9 | 83% | 60-120% |
| Toluene | 91 | 200 | 0 | 235.4 | 118% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 142.4 | 71% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 161.8 | 81% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 210.8 | 105% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 143.6 | 72% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 221.5 | 111% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 224.7 | 112% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 148.2 | 74% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 161.9 | 81% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 169.4 | 85% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 161.9 | 81% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 156.7 | 78% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform * | 173 | 200 | 0 | 102.1 | 51% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 126.3 | 63% | 60-120% |
| Benzyl chloride | 91/126 | | | 121.4 | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 181.8 | 91% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 183.5 | 92% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 239.5 | 120% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 185.7 | 93% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 198.7 | 99% | |

* outside the QA/QC action limits

Table2.2.3.2.19

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | June 17,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane* | 50 | 200 | 0 | 212.6 | 106% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 56.7 | 28% | 60-120% |
| Vinyl Chloride * | 62 | 200 | 0 | 40.9 | 20% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 173.8 | 87% | 40-100% |
| Chloroethane * | 64 | 200 | 0 | 342.2 | 171% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 158.4 | 79% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 204.9 | 102% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 212.9 | 106% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 253.1 | 127% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 188.7 | 94% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride * | 84 | 200 | 0 | 101.4 | 51% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 213.8 | 107% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 143.2 | 72% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 203.4 | 102% | 60-120% |
| Hexane | 56 | 200 | 0 | 176.9 | 88% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 75.2 | 38% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 200.0 | 100% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 189.0 | 95% | 60-120% |
| Carbon tetrachloride * | 117 | 200 | 0 | 328.9 | 164% | 60-120% |
| Benzene * | 78 | 200 | 0 | 57.5 | 29% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 215.5 | 108% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 197.0 | 99% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 214.1 | 107% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 251.5 | 126% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 234.7 | 117% | 60-120% |
| Toluene | 91 | 200 | 0 | 117.5 | 59% | 60-120% |
| trans-1,3-Dichloropropene * | 75 | 200 | 0 | 305.9 | 153% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 210.8 | 105% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 206.9 | 103% | 60-120% |
| 1-Octene * | 70/56 | 200 | 0 | 286.3 | 143% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 202.6 | 101% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 182.6 | 91% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 212.2 | 106% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 195.0 | 98% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 210.3 | 105% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene * | 91 | 200 | 0 | 259.1 | 130% | 60-120% |
| 1,4-Dimethyl-benzene * | 91 | 200 | 0 | 263.3 | 132% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 223.5 | 112% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 129.2 | 65% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 185.7 | 93% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 205.6 | 103% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 167.9 | 84% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 210.9 | 105% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 228 | 114% | |

* outside the QA/QC action limits

Table 2.2.3.2.20

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | June 25,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 200 | 0 | 157.1 | 79% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 244.5 | 122% | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 231.4 | 116% | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 200 | 100% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 203 | 102% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 187.9 | 94% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 356.4 | 178% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 195 | 98% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 210.2 | 105% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 192.9 | 96% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 209.4 | 105% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 181.9 | 91% | 60-120% |
| Hexane | 56 | 200 | 0 | 213.2 | 107% | 60-120% |
| Chloroform | 83 | 200 | 0 | 230.1 | 115% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 215.5 | 108% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 203.9 | 102% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 173.0 | 87% | 60-120% |
| Benzene | 78 | 200 | 0 | 232.1 | 116% | 60-120% |
| 1,2-Dichloropropane * | 63 | 200 | 0 | 247.4 | 124% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 240.7 | 120% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 221.3 | 111% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 158.6 | 79% | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 81.2 | 41% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 225.1 | 113% | 60-120% |
| Toluene | 91 | 200 | 0 | 242.9 | 121% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 217.6 | 109% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 204.8 | 102% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 184.4 | 92% | 60-120% |
| 1-Octene | 70/56 | | | | | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 201.2 | 101% | 60-120% |
| Tetrachloroethene * | 166 | 200 | 0 | 247.7 | 124% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 211.6 | 106% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 202.5 | 101% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 195.7 | 98% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 222.8 | 111% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 213.4 | 107% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 172.1 | 86% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 171.4 | 86% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 185.5 | 93% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 189.6 | 95% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 178.4 | 89% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 189.2 | 95% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 154.3 | 77% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 187.6 | 94% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.21

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | June 26,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 400 | 200% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 244.5 | 122% | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 231.4 | 116% | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 200 | 100% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 203 | 102% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 187.9 | 94% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 356.4 | 178% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 195 | 98% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 210.2 | 105% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 192.9 | 96% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 209.4 | 105% | 60-120% |
| 1,1-Dichloroethane | 63 | | | | | 60-120% |
| Hexane | 56 | 200 | 0 | 213.2 | 107% | 60-120% |
| Chloroform | 83 | 200 | 0 | 230.1 | 115% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 215.5 | 108% | 60-120% |
| 1,2-Dichloroethane | 62 | | | | | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 173.0 | 87% | 60-120% |
| Benzene | 78 | 200 | 0 | 232.1 | 116% | 60-120% |
| 1,2-Dichloropropane | 63 | | | | | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 240.7 | 120% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 221.3 | 111% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 158.6 | 79% | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 81.2 | 41% | 60-120% |
| cis-1,3-Dichloropropene | 75 | | | | | 60-120% |
| Toluene | 91 | 200 | 0 | 242.9 | 121% | 60-120% |
| trans-1,3-Dichloropropene | 75 | | | | | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 204.8 | 102% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 184.4 | 92% | 60-120% |
| 1-Octene | 70/56 | | | | | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 201.2 | 101% | 60-120% |
| Tetrachloroethene * | 166 | 200 | 0 | 247.7 | 124% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 211.6 | 106% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 208.7 | 104% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 195.7 | 98% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 236.7 | 118% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 234.4 | 117% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 172.1 | 86% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 171.4 | 86% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 185.5 | 93% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 189.6 | 95% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 178.4 | 89% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 189.2 | 95% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 154.3 | 77% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 187.6 | 94% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.22

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | July 16,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 56.7 | 28% | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 163.1 | 82% | 60-120% |
| Vinyl Chloride | 62 | 200 | 0 | 109.5 | 55% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 126.5 | 63% | 40-100% |
| Chloroethane | 64 | 200 | 0 | 139.7 | 70% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 189.6 | 95% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 173.1 | 87% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 130.2 | 65% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 90.3 | 45% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 154.2 | 77% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 161.6 | 81% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 161.2 | 81% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 143.1 | 72% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 172.7 | 86% | 60-120% |
| Hexane | 56 | 200 | 0 | 241.1 | 121% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 325.7 | 163% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 222.7 | 111% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 174.7 | 87% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 194.8 | 97% | 60-120% |
| Benzene * | 78 | 200 | 0 | 303.3 | 152% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 201.6 | 101% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 214.9 | 107% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 168.3 | 84% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane * | 83 | 200 | 0 | 173.3 | 87% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 187.1 | 94% | 60-120% |
| Toluene * | 91 | 200 | 0 | 288.7 | 144% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 158.3 | 79% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 103.4 | 52% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 147.9 | 74% | 60-120% |
| 1-Octene * | 70/56 | 200 | 0 | 74.5 | 37% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 180.8 | 90% | 60-120% |
| Tetrachloroethene | 166 | | | | | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 183.2 | 92% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 207.9 | 104% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 172.5 | 86% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | | | | | 60-120% |
| 1,4-Dimethyl-benzene | 91 | | | | | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 118.0 | 59% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 167.3 | 84% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 191.1 | 96% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 153.5 | 77% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 147.9 | 74% | 60-120% |
| 1,2-Dichlorobenzene * | 146 | 200 | 0 | 111.4 | 56% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 166.1 | 83% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.23

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | July 27,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 20.5 | 10% | 40-100% |
| Dichlorodifluoromethane * | 86 | 200 | 0 | 77.7 | 39% | 60-120% |
| Vinyl Chloride * | 62 | 200 | 0 | 96 | 48% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 116.4 | 58% | 40-100% |
| Chloroethane * | 64 | 200 | 0 | 79.6 | 40% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 157 | 79% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 159.3 | 80% | 60-120% |
| Bromoethane * | 108 | 200 | 0 | 108.3 | 54% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 106.7 | 53% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 147.5 | 74% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 186.6 | 93% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 129.2 | 65% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 142.8 | 71% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 133.9 | 67% | 60-120% |
| Hexane * | 56 | 200 | 0 | 106.4 | 53% | 60-120% |
| Chloroform | 83 | 200 | 0 | 170.3 | 85% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 151.7 | 76% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 157.1 | 79% | 60-120% |
| Carbon tetrachloride * | 117 | 200 | 0 | 100.3 | 50% | 60-120% |
| Benzene | 78 | 200 | 0 | 166.6 | 83% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 168 | 84% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 157.9 | 79% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 157 | 79% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 130 | 65% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 163.6 | 82% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 162.8 | 81% | 60-120% |
| Toluene | 91 | 200 | 0 | 177.9 | 89% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 173.5 | 87% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 185.5 | 93% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 176.6 | 88% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 166 | 83% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 171.7 | 86% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 170.3 | 85% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 186.7 | 93% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 195.1 | 98% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 209.7 | 105% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 195.9 | 98% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 189.4 | 95% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 194.4 | 97% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 190.2 | 95% | 60-120% |
| Benzyl chloride | 91/126 | | | | | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 197.0 | 99% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 198.1 | 99% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 206.7 | 103% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 215.2 | 108% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 175.1 | 88% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.24

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TMC

Instrument GC/MS Analysis Date Aug. 4,1987

Matrix Type Water Blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | | | | | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 171.4 | 86% | 60-120% |
| Vinyl Chloride * | 62 | 200 | 0 | 77.4 | 39% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 158.3 | 79% | 40-100% |
| Chloroethane | 64 | 200 | 0 | 200 | 100% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 223.5 | 112% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 181.6 | 91% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 185 | 93% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 123.1 | 62% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 192.4 | 96% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 219.4 | 110% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 184.8 | 92% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 155.7 | 78% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 206.9 | 103% | 60-120% |
| Hexane | 56 | 200 | 0 | 168.9 | 84% | 60-120% |
| Chloroform * | 83 | 200 | 0 | 340.2 | 170% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 206.5 | 103% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 194.5 | 97% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 187.6 | 94% | 60-120% |
| Benzene * | 78 | 200 | 0 | 423.0 | 212% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 229.2 | 115% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 213.1 | 107% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 186.1 | 93% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | | | | | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 177.9 | 89% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 193.6 | 97% | 60-120% |
| Toluene | 91 | 200 | 0 | 201.2 | 101% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 171.8 | 86% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 185.8 | 93% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 203.6 | 102% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 233 | 117% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 190.7 | 95% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 172.9 | 86% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 214.5 | 107% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 183.9 | 92% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 172.1 | 86% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 206.6 | 103% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 171.4 | 86% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 180.8 | 90% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 182.5 | 91% | 60-120% |
| Benzyl chloride * | 91/126 | 200 | 0 | 31.6 | 16% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 191.3 | 96% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 210.1 | 105% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 220.4 | 110% | 60-120% |
| 1,2-Dichlorobenzene * | 146 | 200 | 0 | 569.5 | 285% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 174.8 | 87% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.25

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | TMC |
| Instrument | GC/MS | Analysis Date | Aug. 10,1987 |
| Matrix Type | Water Blank | | |

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | | | | | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 148.3 | 74% | 60-120% |
| Vinyl Chloride | 62 | 200 | 0 | 96.2 | 48% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 186.7 | 93% | 40-100% |
| Chloroethane * | 64 | 200 | 0 | 81.1 | 41% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 148.1 | 74% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 119.7 | 60% | 60-120% |
| Bromoethane * | 108 | 200 | 0 | 115.4 | 58% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 68 | 34% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 142.4 | 71% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 207.8 | 104% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 139.5 | 70% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 133.3 | 67% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 122.1 | 61% | 60-120% |
| Hexane | 56 | 200 | 0 | 148.9 | 74% | 60-120% |
| Chloroform | 83 | 200 | 0 | 133.8 | 67% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 154.0 | 77% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 162.5 | 81% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 140.5 | 70% | 60-120% |
| Benzene | 78 | 200 | 0 | 176.4 | 88% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 171.9 | 86% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 163.4 | 82% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 171.8 | 86% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 182 | 91% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 179.5 | 90% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 136.4 | 68% | 60-120% |
| Toluene | 91 | 200 | 0 | 162.3 | 81% | 60-120% |
| trans-1,3-Dichloropropene * | 75 | 200 | 0 | 103.7 | 52% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 172.5 | 86% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 177.6 | 89% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 159.1 | 80% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 192.3 | 96% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 167.5 | 84% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 163.5 | 82% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 146.9 | 73% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 165.0 | 83% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 137.0 | 69% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 238.9 | 119% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 151.3 | 76% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 153.0 | 77% | 60-120% |
| Benzyl chloride * | 91/126 | 200 | 0 | 84.8 | 42% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 158.7 | 79% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 162.7 | 81% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 169.9 | 85% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 154.2 | 77% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 171.5 | 86% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.26

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TMC

Instrument GC/MS Analysis Date Aug. 14,1987

Matrix Type water blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane * | 50 | 200 | 0 | 60 | 30% | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 165.5 | 83% | 60-120% |
| Vinyl Chloride | 62 | | | | | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 112.1 | 56% | 40-100% |
| Chloroethane | 64 | | | | | 60-120% |
| Diethyl ether * | 45 | 200 | 0 | 294.3 | 147% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 167.4 | 84% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 129.4 | 65% | 60-120% |
| 3-Chloro-1-propene * | 76 | 200 | 0 | 78.6 | 39% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 154.9 | 77% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 180.8 | 90% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 164.2 | 82% | 60-120% |
| trans-1,2-Dichloroethene * | 61 | 200 | 0 | 62.9 | 31% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 185.7 | 93% | 60-120% |
| Hexane * | 56 | 200 | 0 | 270.3 | 135% | 60-120% |
| Chloroform | 83 | 200 | 0 | 221.3 | 111% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 219.0 | 110% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 226.4 | 113% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 233.5 | 117% | 60-120% |
| Benzene * | 78 | 200 | 0 | 287.2 | 144% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 221.5 | 111% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 175.4 | 88% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 181.7 | 91% | 60-120% |
| bis(2-Chloroethylvinyl) ether* | 63 | 200 | 0 | 337.1 | 169% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 213.8 | 107% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 174.2 | 87% | 60-120% |
| Toluene | 91 | 200 | 0 | 212.3 | 106% | 60-120% |
| trans-1,3-Dichloropropene * | 75 | 200 | 0 | 411.3 | 206% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 181.4 | 91% | 60-120% |
| 1,1,2-Trichloroethane * | 83 | 200 | 0 | 55.4 | 28% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 158.2 | 79% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 188.3 | 94% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 187.8 | 94% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 155.3 | 78% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 228.8 | 114% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 194.5 | 97% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 164.7 | 82% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 194.4 | 97% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 197.3 | 99% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 207.2 | 104% | 60-120% |
| Benzyl chloride * | 91/126 | 200 | 0 | 31.9 | 16% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 171.4 | 86% | 60-120% |
| 1,3-Dichlorobenzene | 146 | 200 | 0 | 153.4 | 77% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 168.0 | 84% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 211.6 | 106% | 60-120% |
| Bromodichlorobenzene | 226 | 200 | 0 | 168.9 | 84% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.27

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-MATRIX SPIKE RECOVERY SUMMARY

Project ID: AN873095 Analyst TMC

Instrument GC/MS Analysis Date Aug. 17,1987

Matrix Type Water Blank

| PARAMETERS | Ions (m/z) | AMOUNT ADDED (ug/L) | SAMPLE CONC. (ug/L) | AMOUNT FOUND (ug/L) | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Recovery Range |
|---|---|---|---|---|---|---|
| Chloromethane | 50 | 200 | 0 | 79.4 | 40% | 40-100% |
| Dichlorodifluoromethane | 86 | 200 | 0 | 165.5 | 83% | 60-120% |
| Vinyl Chloride * | 62 | 200 | 0 | 72.2 | 36% | 40-100% |
| Vinyl bromide | 106 | 200 | 0 | 139.4 | 70% | 40-100% |
| Chloroethane | 64 | 200 | 0 | 121.6 | 61% | 60-120% |
| Diethyl ether | 45 | 200 | 0 | 172.5 | 86% | 40-100% |
| Trichlorofluoromethane | 101 | 200 | 0 | 151 | 76% | 60-120% |
| Bromoethane | 108 | 200 | 0 | 146 | 73% | 60-120% |
| 3-Chloro-1-propene | 76 | 200 | 0 | 225.2 | 113% | 60-120% |
| 1,1-Dichloroethene | 61 | 200 | 0 | 158.9 | 79% | 60-120% |
| Acrolein | 55/56 | | | | | 40-100% |
| Acrylonitrile | 53 | | | | | 40-100% |
| Methylene chloride | 84 | 200 | 0 | 198.3 | 99% | 60-120% |
| cis-1,2-Dichloroethene | 61 | 200 | 0 | 193.4 | 97% | 60-120% |
| trans-1,2-Dichloroethene | 61 | 200 | 0 | 164.9 | 82% | 60-120% |
| 1,1-Dichloroethane | 63 | 200 | 0 | 198.8 | 99% | 60-120% |
| Hexane * | 56 | 200 | 0 | 316.7 | 158% | 60-120% |
| Chloroform | 83 | 200 | 0 | 207.7 | 104% | 60-120% |
| 1,1,1-Trichloroethane | 97 | 200 | 0 | 218.2 | 109% | 60-120% |
| 1,2-Dichloroethane | 62 | 200 | 0 | 199.7 | 100% | 60-120% |
| Carbon tetrachloride | 117 | 200 | 0 | 198.1 | 99% | 60-120% |
| Benzene * | 78 | 200 | 0 | 249.2 | 125% | 60-120% |
| 1,2-Dichloropropane | 63 | 200 | 0 | 176.9 | 88% | 60-120% |
| Trichloroethene | 130 | 200 | 0 | 167.9 | 84% | 60-120% |
| Dibromomethane | 174 | 200 | 0 | 165.4 | 83% | 60-120% |
| bis(2-Chloroethylvinyl) ether | 63 | 200 | 0 | 150.4 | 75% | 60-120% |
| Bromodichloromethane | 83 | 200 | 0 | 170.5 | 85% | 60-120% |
| cis-1,3-Dichloropropene | 75 | 200 | 0 | 154.1 | 77% | 60-120% |
| Toluene | 91 | 200 | 0 | 185.1 | 93% | 60-120% |
| trans-1,3-Dichloropropene | 75 | 200 | 0 | 192.6 | 96% | 60-120% |
| 1,2-Dibromoethane | 107 | 200 | 0 | 179.7 | 90% | 60-120% |
| 1,1,2-Trichloroethane | 83 | 200 | 0 | 139.9 | 70% | 60-120% |
| 1-Octene | 70/56 | 200 | 0 | 184.9 | 92% | 60-120% |
| Dibromochloromethane | 129 | 200 | 0 | 176.9 | 88% | 60-120% |
| Tetrachloroethene | 166 | 200 | 0 | 163.0 | 82% | 60-120% |
| Chlorobenzene | 112 | 200 | 0 | 211.3 | 106% | 60-120% |
| Ethylbenzene | 91 | 200 | 0 | 207.2 | 104% | 60-120% |
| Styrene | 90/104 | 200 | 0 | 170.7 | 85% | 40-100% |
| 1,2 & 1,3-Dimethyl-benzene | 91 | 200 | 0 | 189.5 | 95% | 60-120% |
| 1,4-Dimethyl-benzene | 91 | 200 | 0 | 159.4 | 80% | 60-120% |
| Hexanol | 55/56 | | | | | 60-120% |
| Bromoform | 173 | 200 | 0 | 133.8 | 67% | 60-120% |
| 1,1,2,2-Tetrachloroethane | 83 | 200 | 0 | 145.9 | 73% | 60-120% |
| Benzyl chloride | 91/126 | 200 | 0 | 124.5 | 62% | 60-120% |
| 3-Chloro-toluene | 91/126 | 200 | 0 | 142.2 | 71% | 60-120% |
| 1,3-Dichlorobenzene * | 146 | 200 | 0 | 108.1 | 54% | 60-120% |
| 1,4-Dichlorobenzene | 146 | 200 | 0 | 162.2 | 81% | 60-120% |
| 1,2-Dichlorobenzene | 146 | 200 | 0 | 180.8 | 90% | 60-120% |
| Bromodichlorobenzene * | 226 | 200 | 0 | 87.3 | 44% | 60-120% |

* outside the QA/QC action limits

Table 2.2.3.2.28

# VOA-WATER SPIKE RECOVERY
## (3-Chloro-1-propene)

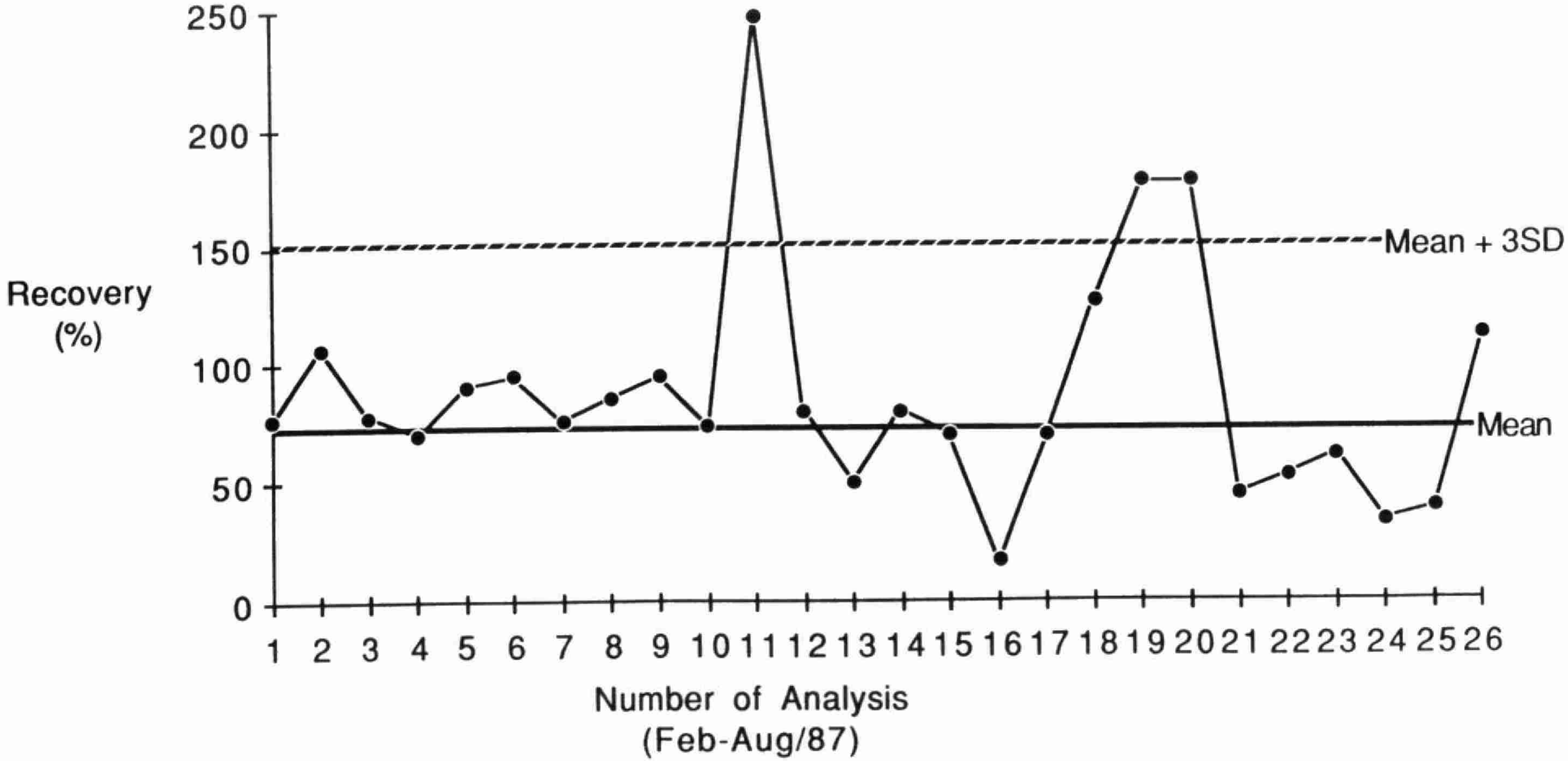



Fig. 2.2.3.2.1

## VOA-WATER SPIKE RECOVERY
## (Methylene Chloride)

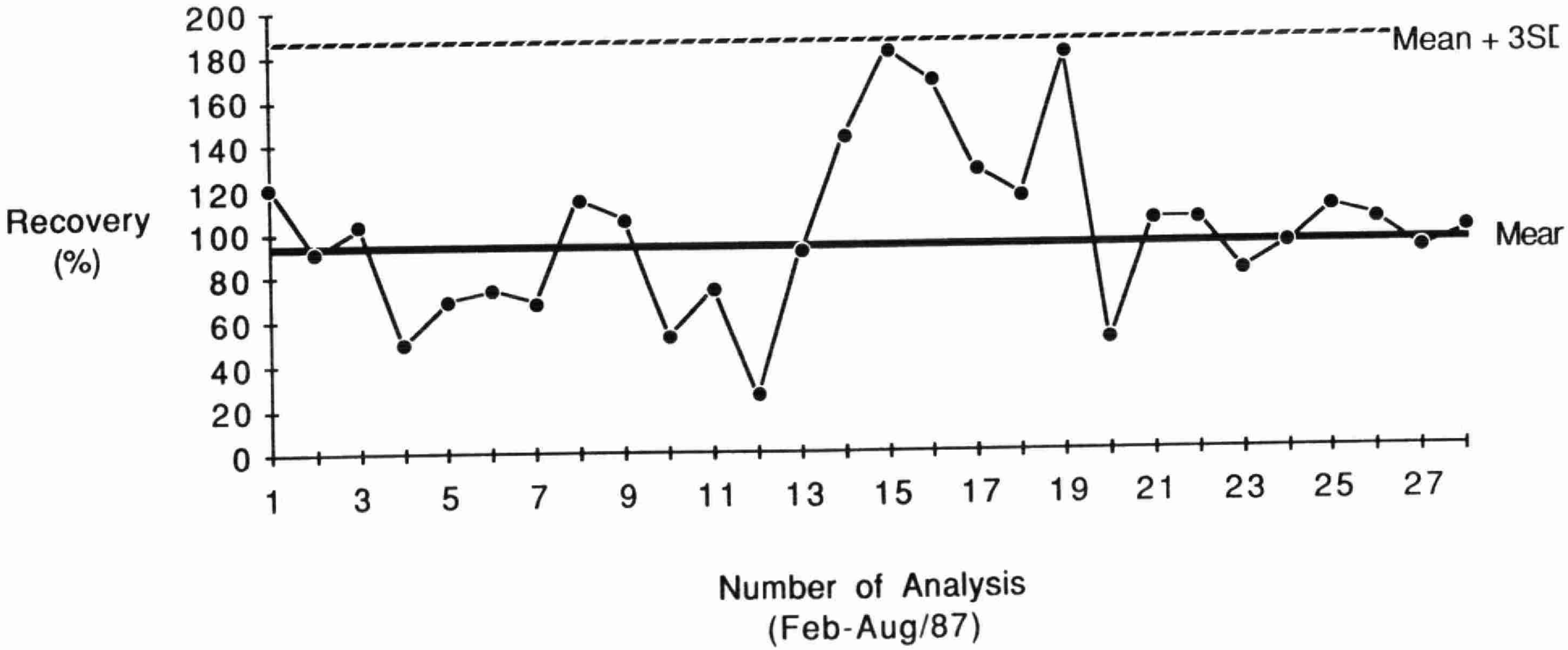



Fig. 2.2.3.2.2

# VOA-WATER SPIKE RECOVERY
## (Hexane)

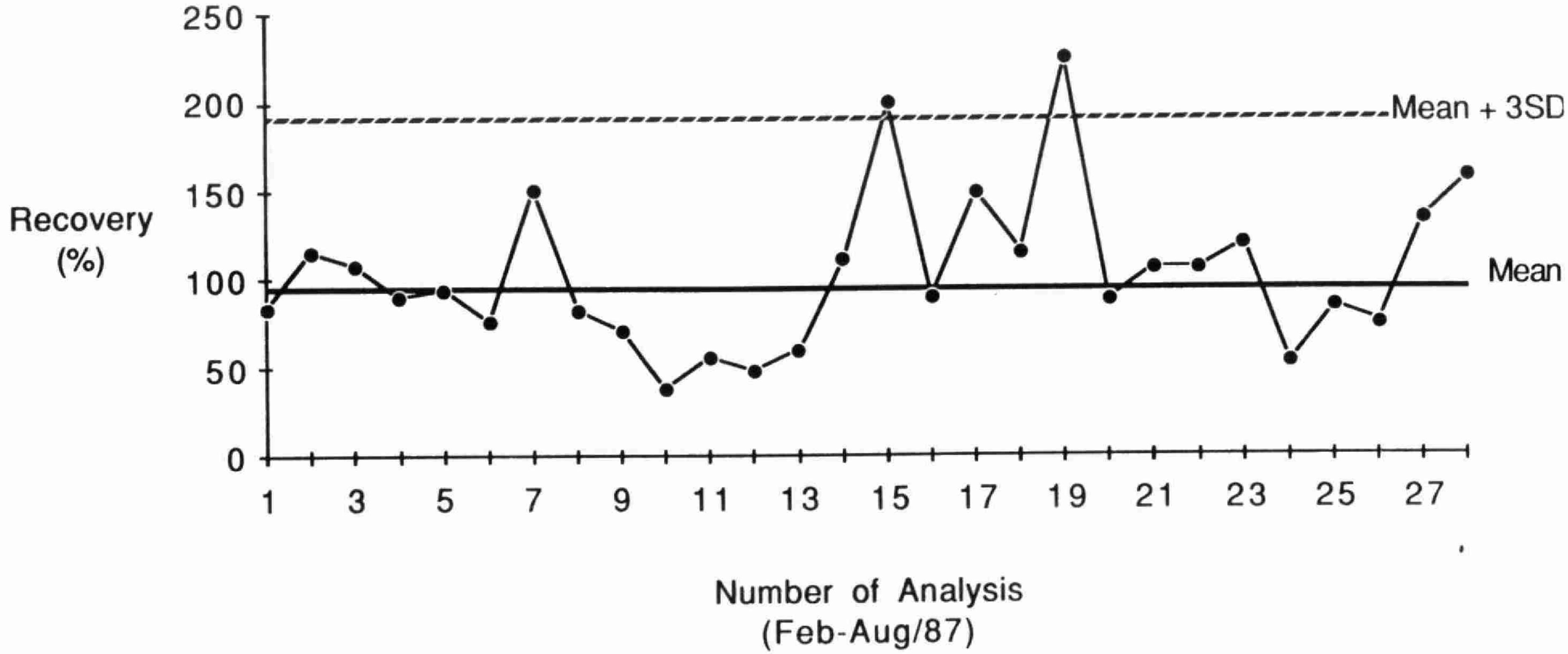
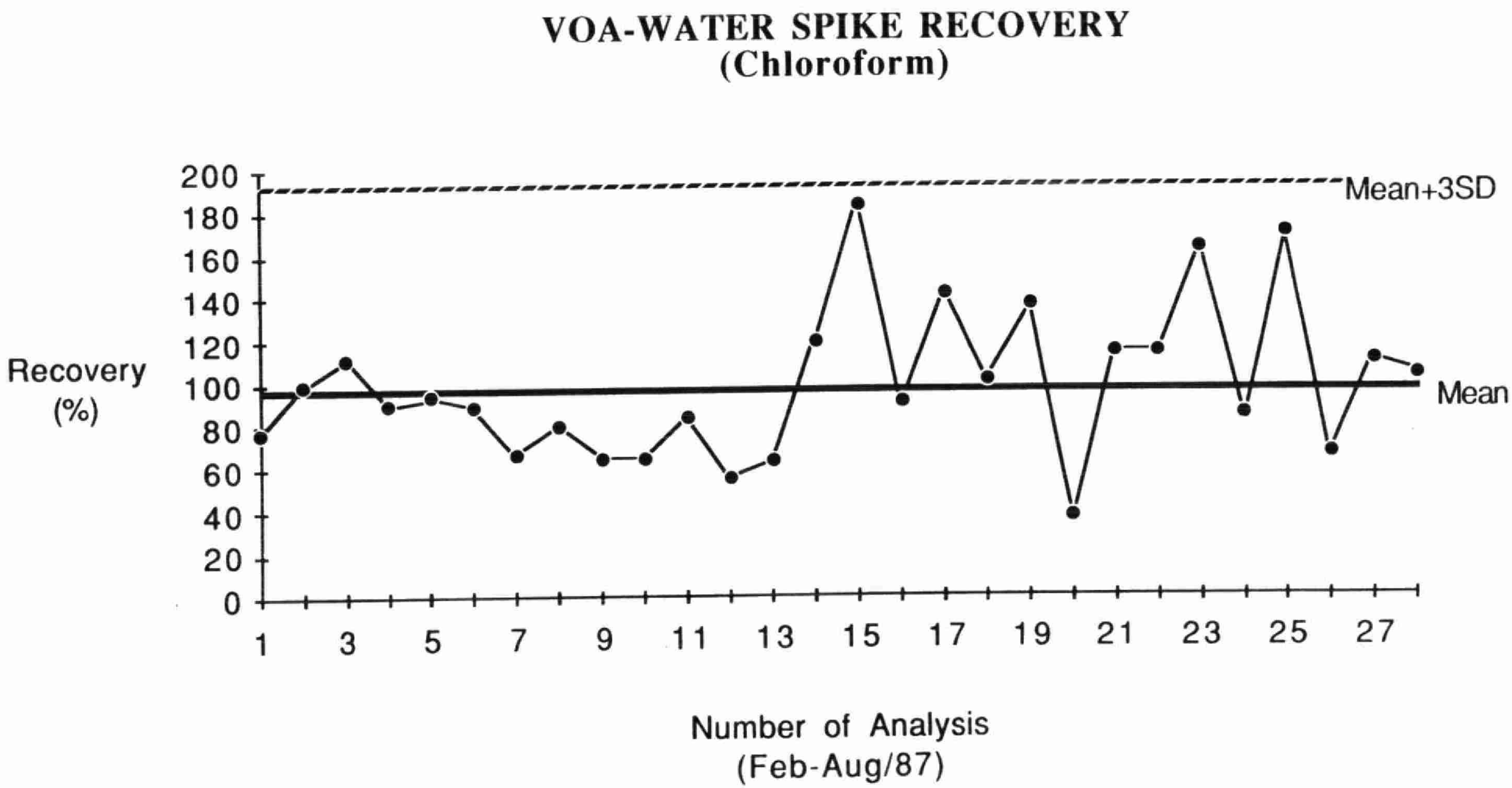





Fig. 2.2.3.2.3



VOA-WATER SPIKE RECOVERY
(Chloroform)
200
180
160
140
120
100
80
60
40
20
0
Recovery
(%)
Mean+3SD
Mean
1
3
5
7
9
11
13
15
17
19
21
23
25
27
Number of Analysis
(Feb-Aug/87)


Fig. 2.2.3.2.4

# VOA-WATER SPIKE RECOVERY
## (1,1,1-Trichloroethane)

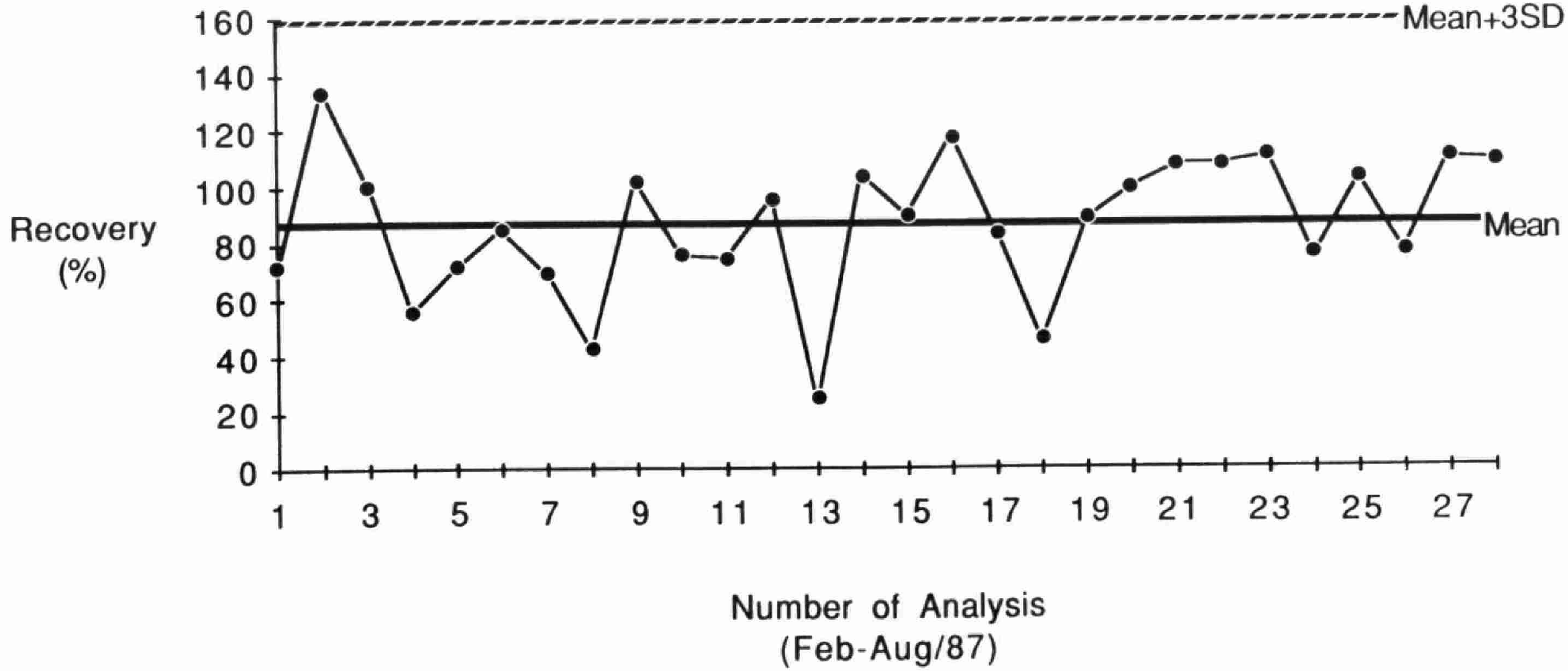



Fig. 2.2.3.2.5

## VOA-WATER SPIKE RECOVERY
## (Benzene)

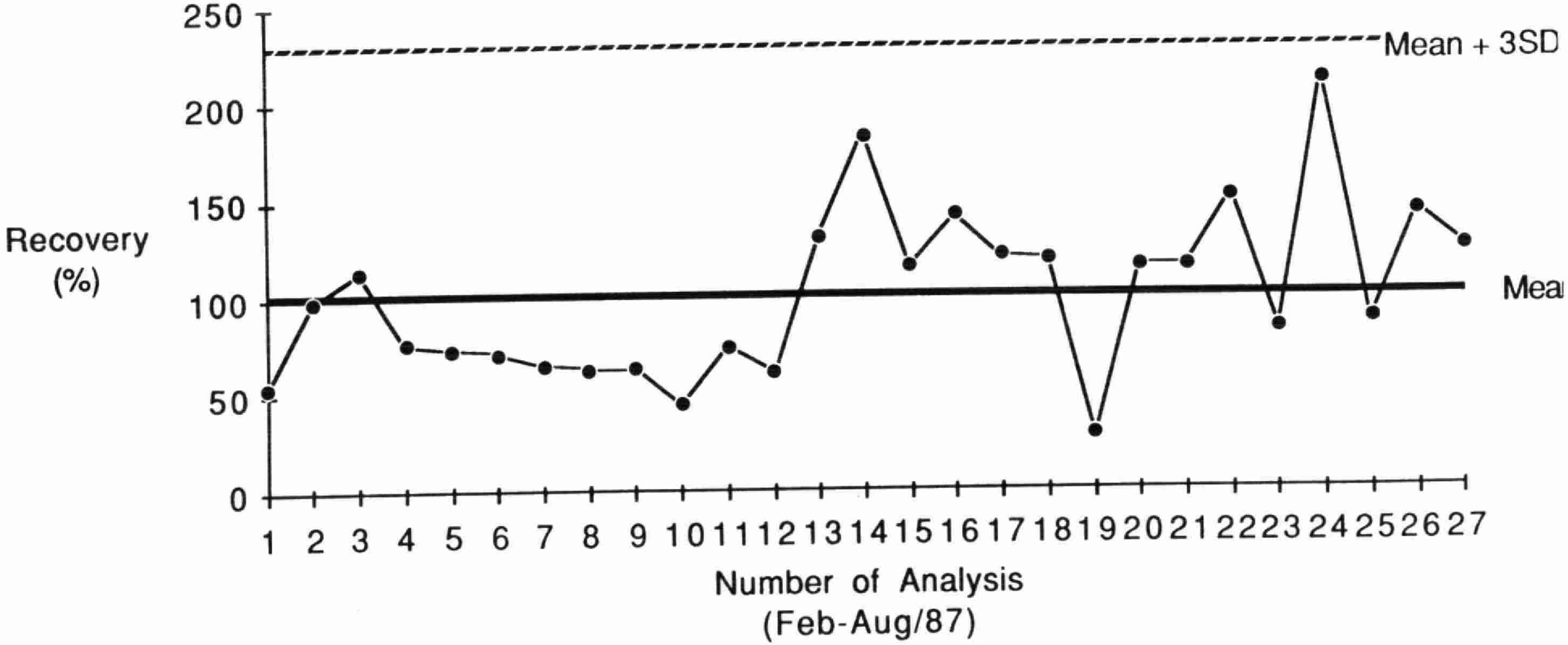
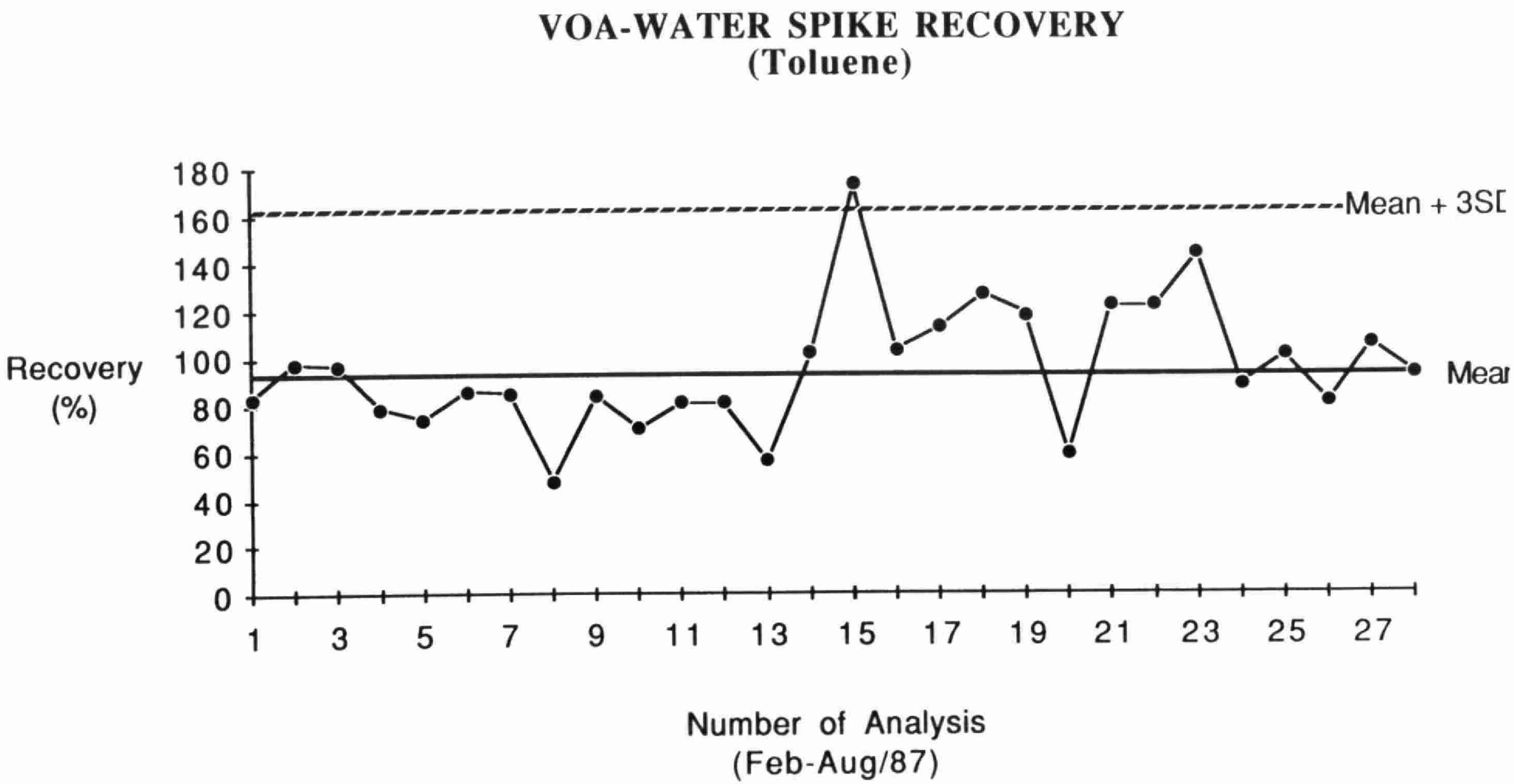



Fig. 2.2.3.2.6



VOA-WATER SPIKE RECOVERY
(Toluene)
Recovery
(%)
180
160
140
120
100
80
60
40
20
0
Mean + 3SI
Mear
1
3
5
7
9
11
13
15
17
19
21
23
25
27
Number of Analysis
(Feb-Aug/87)


Fig. 2.2.3.2.7

## VOA-WATER SPIKE RECOVERY
(Ethylbenzene)

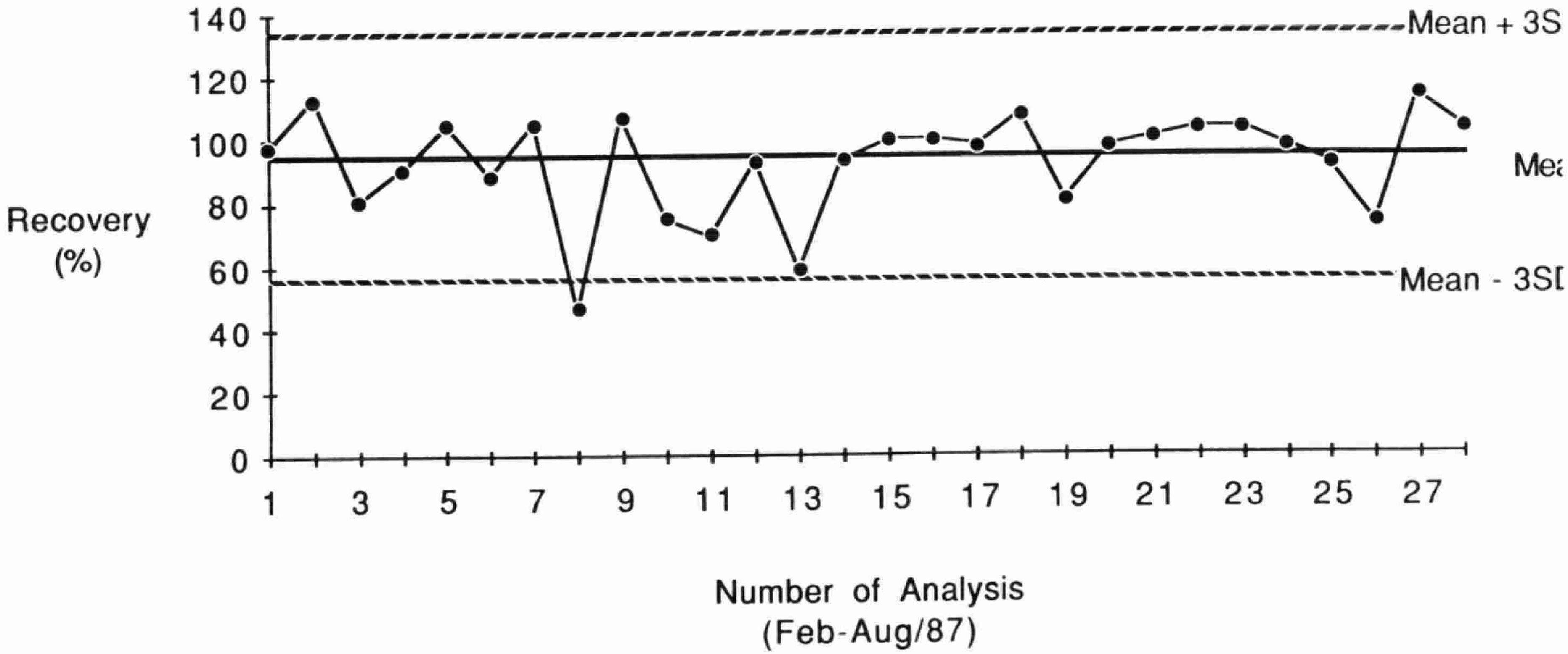



Fig. 2.2.3.2.8

## VOA-WATER SPIKE RECOVERY
## (1,2 & 1,3-Dimethyl-benzene)

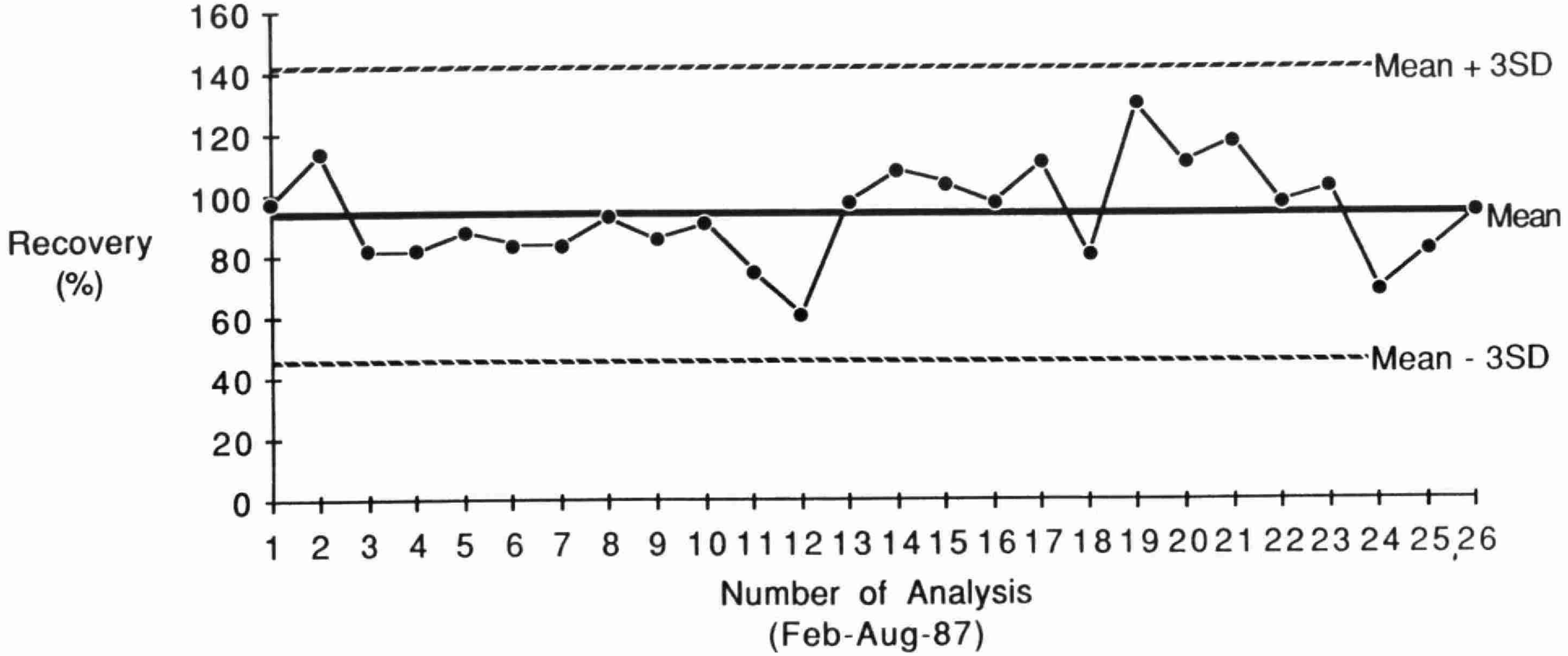



Fig. 2.2.3.2.9

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**VOA-WATER SPIKE RECOVERY**
**(1,4-Dimethyl-benzene)**

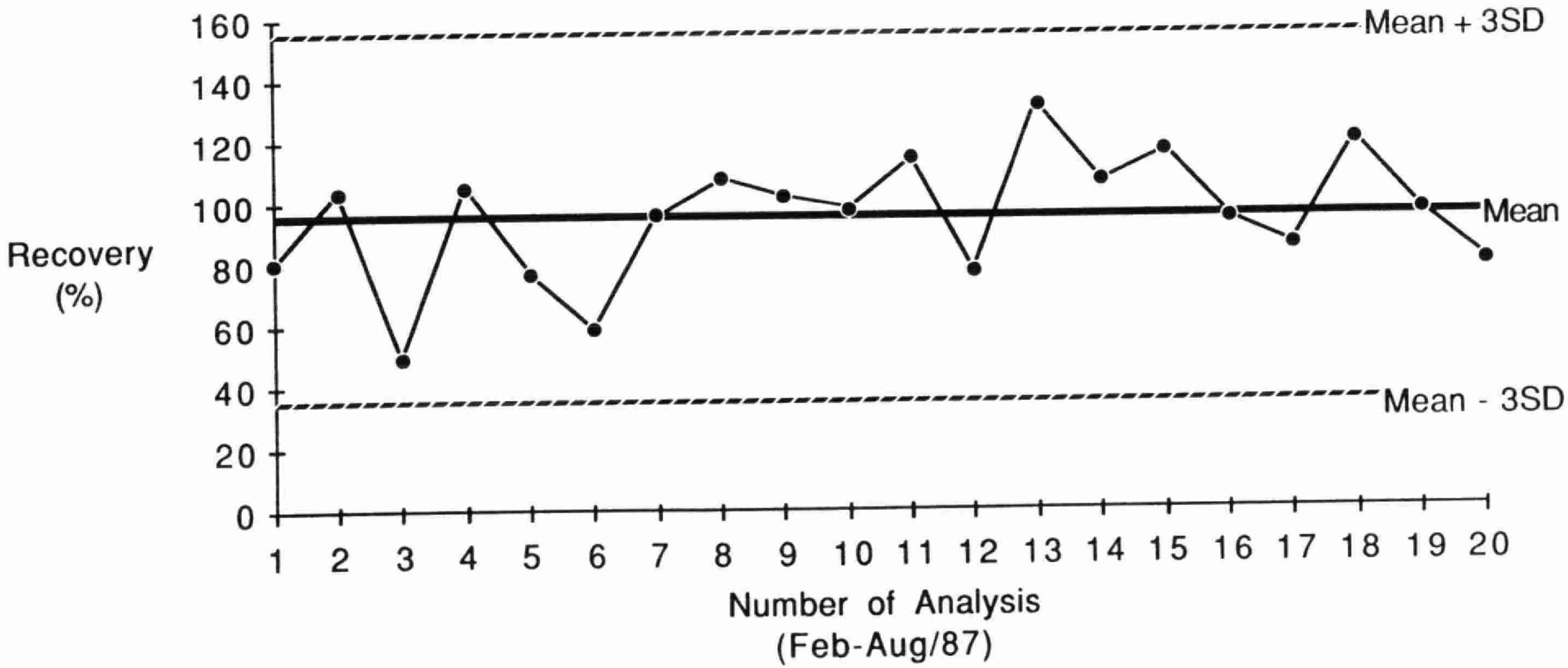



Fig. 2.2.3.2.10

## Water Spike Recovery
## Box-Wisker Method
## (Vinyl Chloride/Dichlorodifluoromethane/Chloromethane)

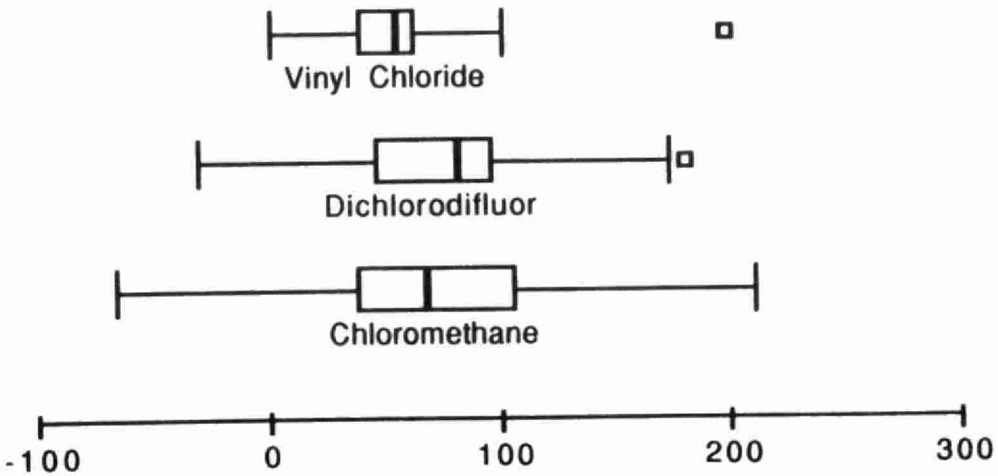





Fig. 2.2.3.2.11

Water Spike Recovery
Box-Wisker Method
(Diethyl Ether/Chloroethane/Vinyl Bromide)

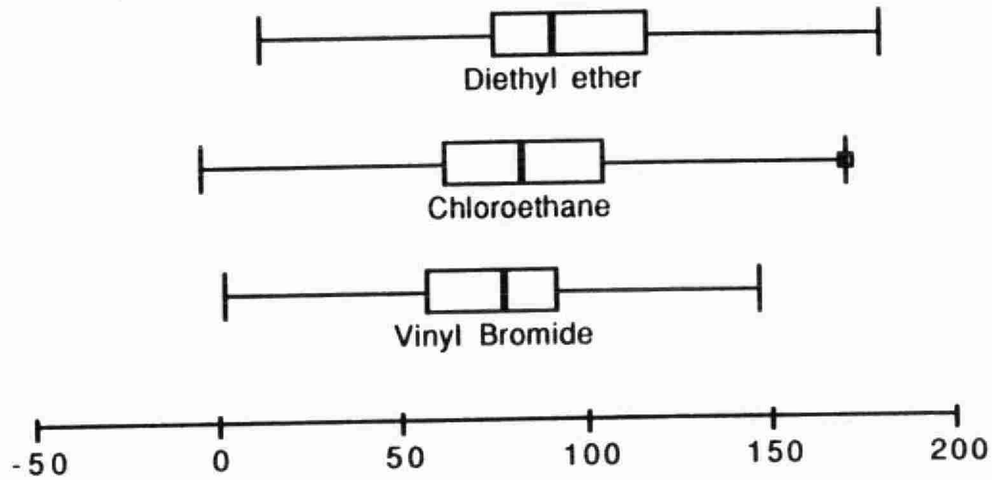



Fig. 2.2.3.2.12

## Water Spike Recovery
## Box-Wisker Method
## (3-Chloro-1-propene/Bromoethane/Trichlorofluoromethane)

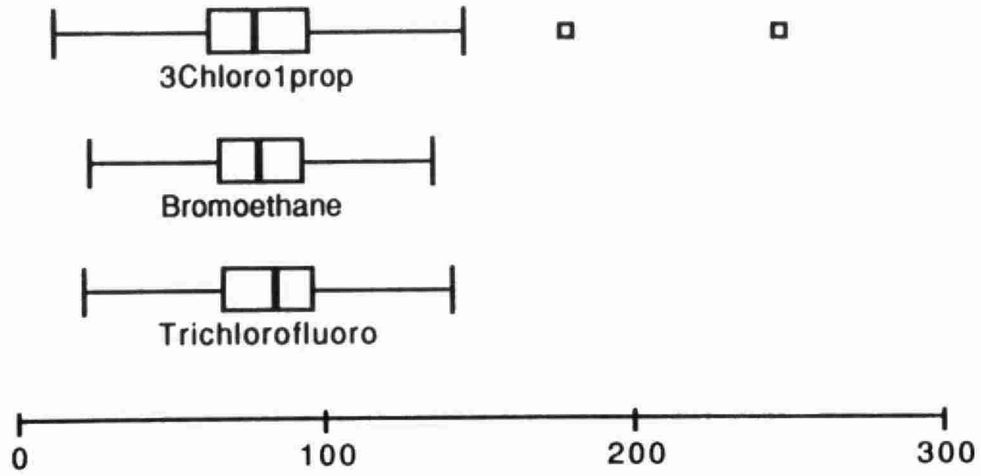



Fig. 2.2.3.2.13

Water Spike Recovery
Box-Wisker Method
(cis-Dichloroethene/Methylene Chloride/1,1-Dichloroethene)

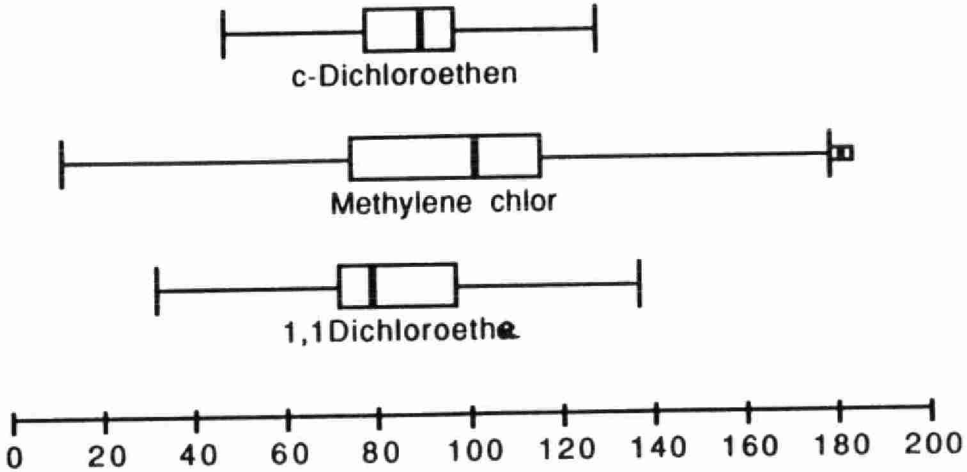



Fig. 2.2.3.2.14

Water Spike Recovery
Box-Wisker Method
(Hexane/1,1-Dichloroethane/trans-1,2-Dichloroethane)

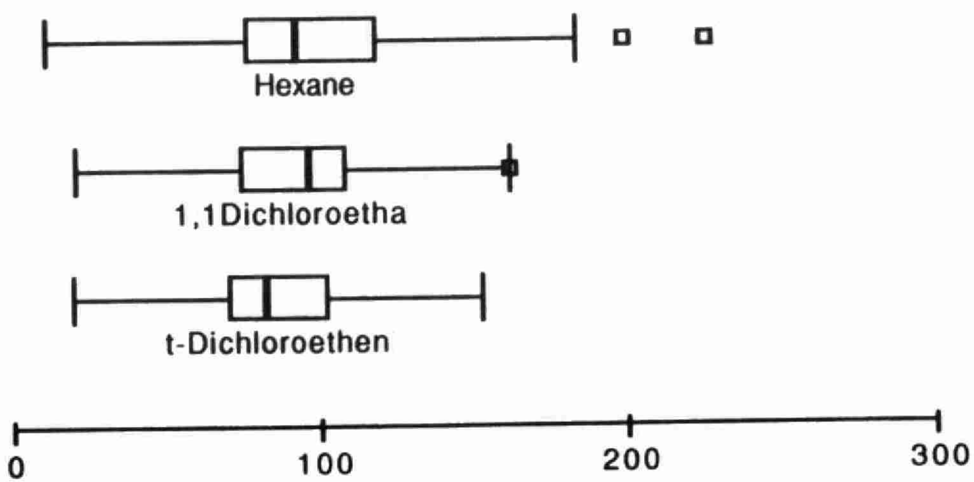



Fig. 2.2.3.2.15

Water Spike Recovery
Box-Wisker Method
(1,2-Dichloroethane/1,1,1-Trichloroethane/Chloroform)

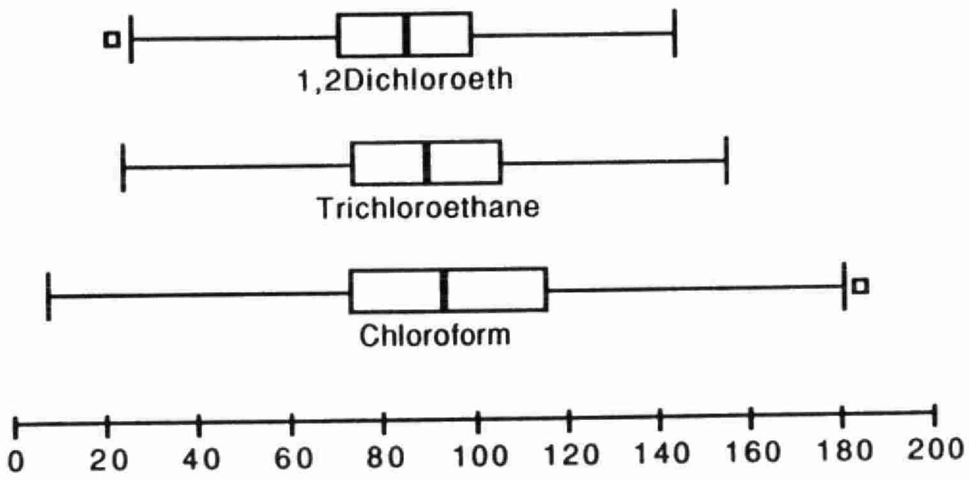



Fig. 2.2.3.2.16

Water Spike Recovery
Box-Wisker Method
(1,2-Dichloropropane/Benzene/Carbon Tetrachloride)

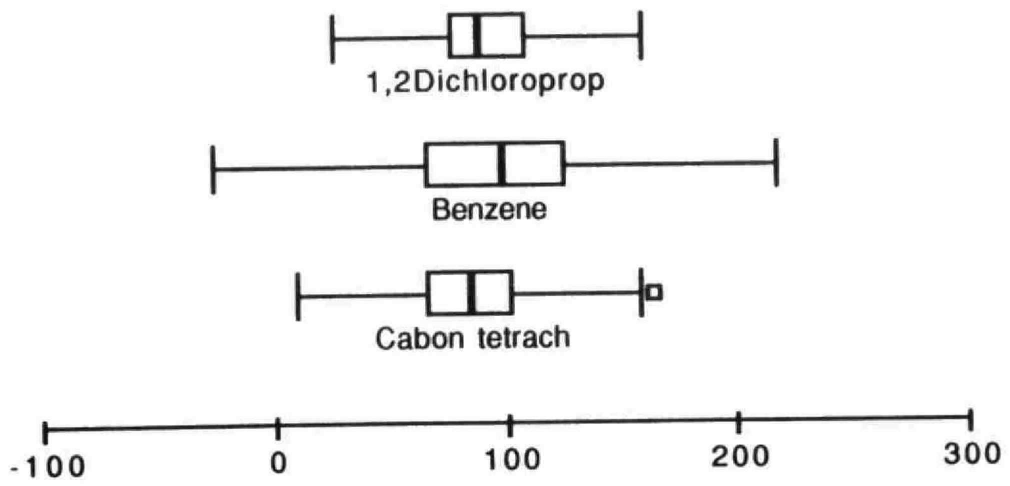



Fig. 2.2.3.2.17

Water Spike Recovery
Box-Wisker Method
(Bromodichloromethane/bis 2-Chloroethyl vinyl ether/)
1,2-Dibromoethane

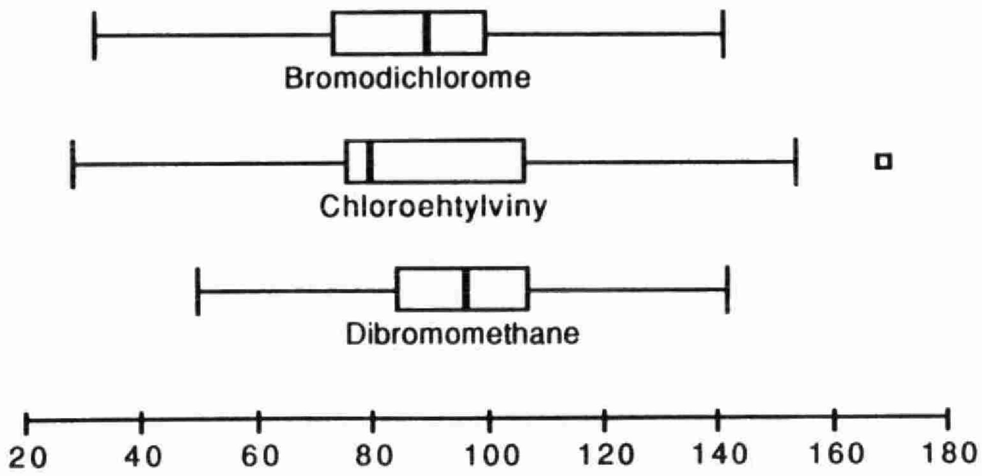



Fig. 2.2.3.2.18

Water Spike Recovery
Box-Wisker Method
(Bromodichloromethane/Trichloroethene)

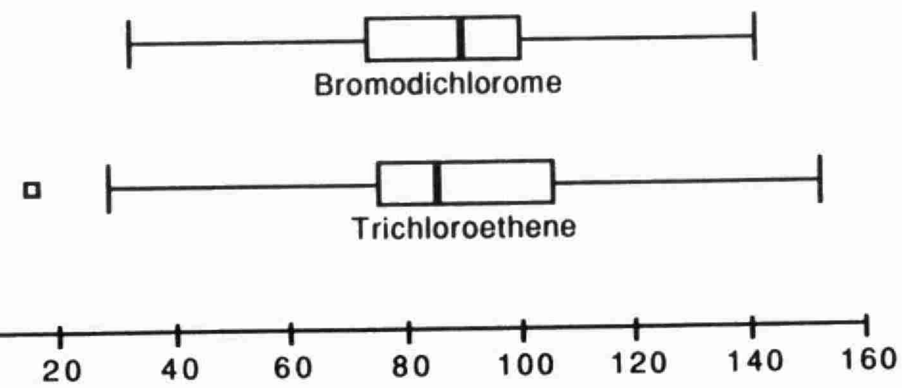



Fig. 2.2.3.2.19

## Water Spike Recovery
## Box-Wisker Method
## (trans-Dichloropropene/Toluene/cis-1,3-Dichloropropene)

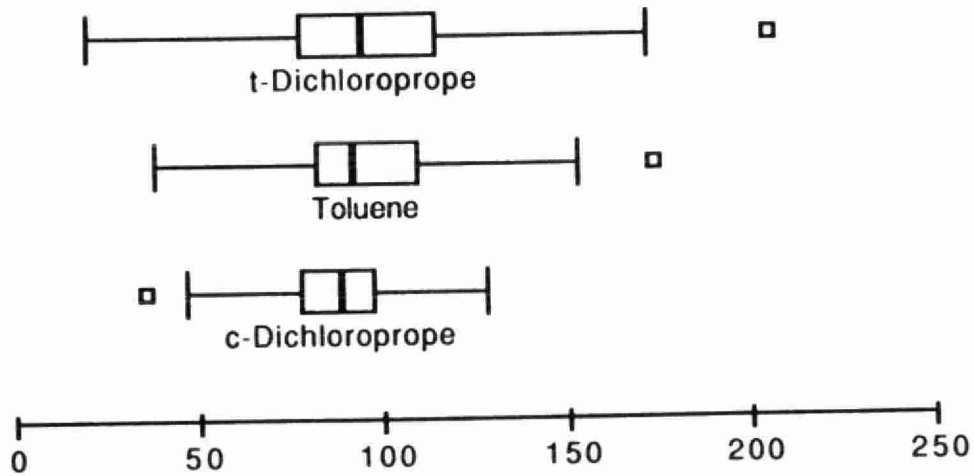



Fig. 2.2.3.2.20

Water Spike Recovery
Box-Wisker Method
(1-Octane/1,1,2-Trichloroethane/1,2-Dibromoethane)

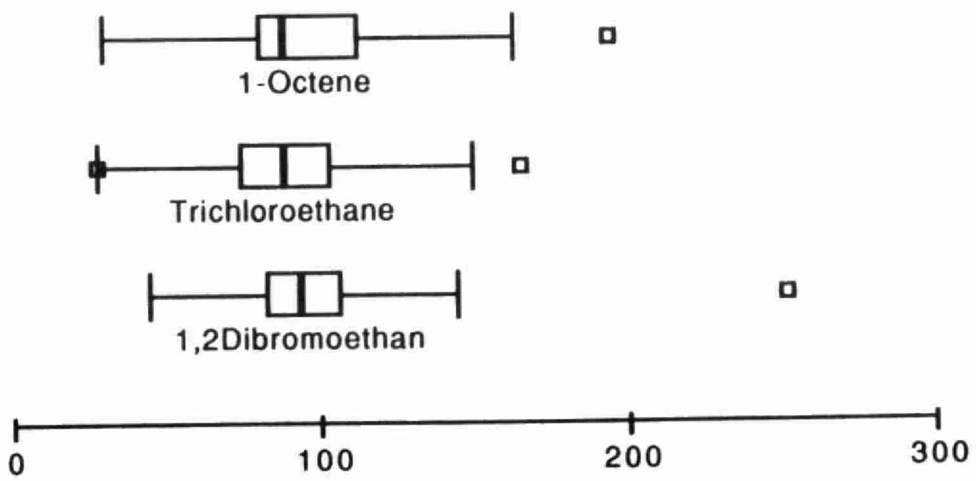



Fig. 2.2.3.2.21

Water Spike Recovery
Box-Wisker Method
(Chlorobenzene/Tetrachloroethene/Dibromochloromethane)

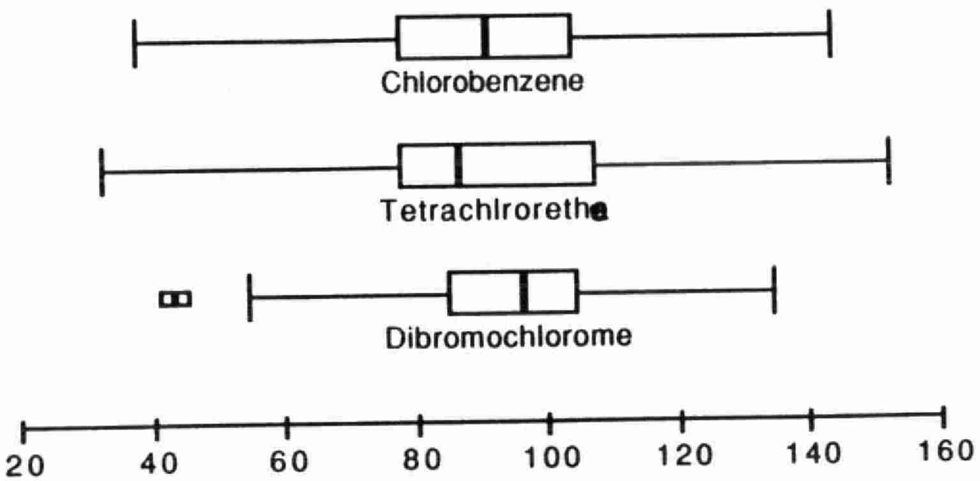



Fig. 2.2.3.2.22

Water Spike Recovery
Box-Wisker Method
(1,2 & 1,3-Xylene/Styrene/Ethylbenzene)

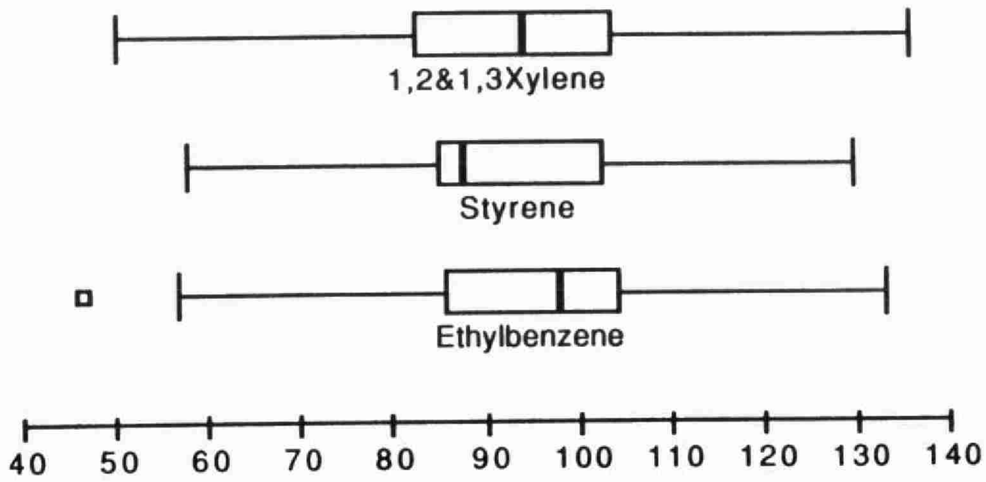



Fig. 2.2.3.2.23

Water Spike Recovery
Box-Wisker Method
(Bromoform/Haxanol/1,4-Xylene)

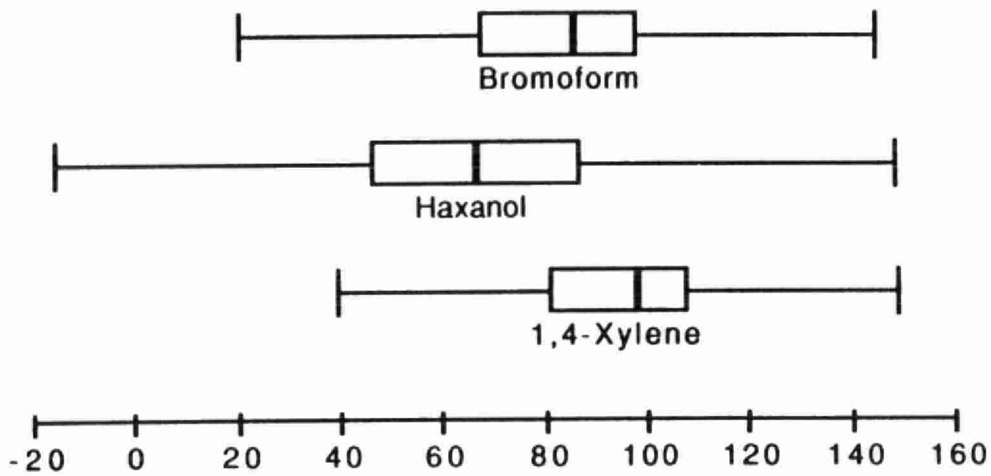



Fig. 2.2.3.2.24

## Water Spike Recovery
## Box-Wisker Method
## (3-Chloro-toluene/Benzyl chloride/1,1,2,2-Tetrachloroethane)

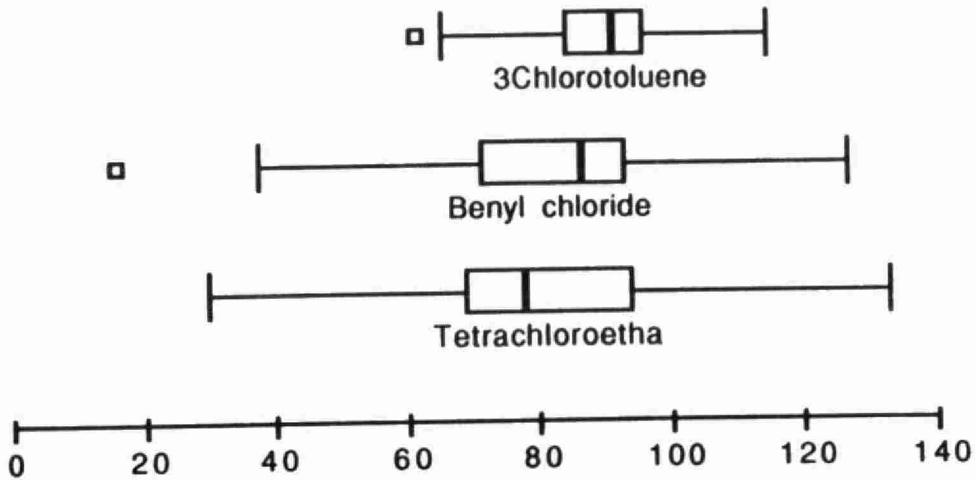



Fig.2.2.3.2.25

Water Spike Recovery
Box-Wisker Method
(1,2Dichlorobenzene/1,4Dichlorobenzene/1,3Dichlorobenzene)

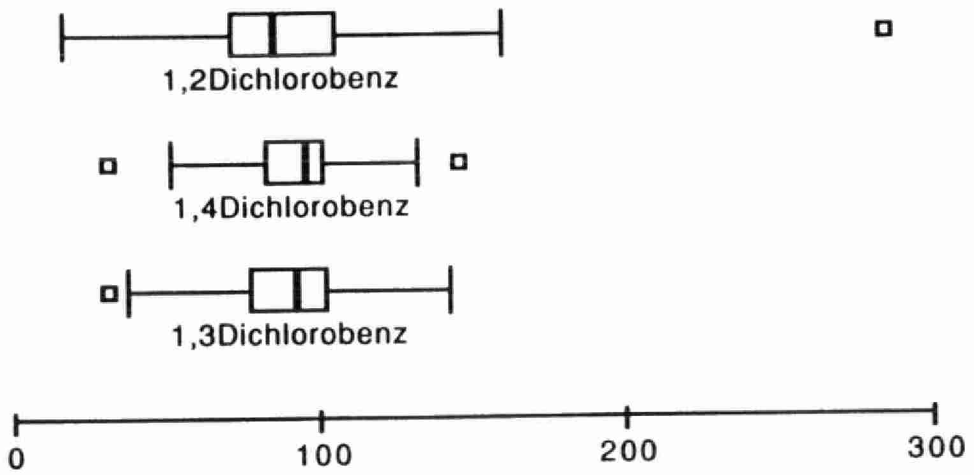



Fig.2.2.3.2.26

Water Spike Recovery
Box-Wisker Method
(Bromodichlorobenzene)

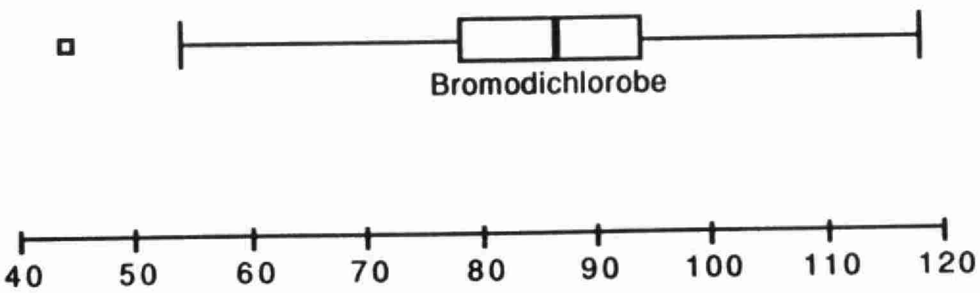



Fig.2.2.3.2.27

**ZENON ENVIRONMENTAL INC.**

**VOLATILE ORGANIC COMPOUND-METHOD BLANK SUMMARY**

| Analysis Date | Concentration(ug/L) Methylene Chloride | Chloroform | Benzene | Toluene | Tetrachloro-ethylene | Ethyl Benzene | Xylenes | 1,4-DCB | Hexane | 1,1-Dichloro-ethene | BrCl2CH | Br2ClCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan.28,87' | | | 4 | 2 | 1 | | | | 9 | | | |
| Jan.28,87' | 8 | 10 | 20 | 25 | 12 | | | | 26 | | | |
| Feb.5,87' | 1 | | | | | | 1 | | | | | |
| Feb.6,87' | | | 3 | | | | | | | | | |
| Feb.12,87'* | 97 | | | 3 | | | | | | | | |
| Feb.17,87 | 13 | | 9 | 1 | | | | | | | | |
| Feb.23,87 | 12 | | 4 | 23 | | | | | 25 | | | |
| Feb.24,87' | 6 | | 5 | 3 | | | | | | | | |
| Feb.25,87' | 2 | | 3 | 2 | | | | | | | | |
| Feb.26,87' | 11 | | 4 | 3 | | | | | | | | |
| Feb.27,87' | 13 | | 3 | 2 | | | | | | | | |
| Feb.28,87' | 6 | | 4 | 2 | | | | | | | | |
| Mar.2,87' | 6 | | 1 | 12 | | 2 | 2 | 6 | | | | |
| Mar.5,87' | 20 | 3 | 7 | 3 | | | | | | | | |
| Mar.6,87' | 19 | 1 | 4 | 1 | | | | | | | | |
| Mar.6,87' | 16 | 1 | 5 | 1 | | | | | | | | |
| Mar.8,87' * | 51 | 5 | 13 | 8 | | | | | | | | |
| Mar.9,87' | 10 | 4 | 7 | 4 | | | | | 4 | 10 | | |
| Mar.12,87' | 15 | 2 | 3 | | | | | | 2 | | | |
| Mar.10,87' | 15 | 4 | 7 | 4 | | | | | 4 | | | |
| Mar.20,87' | 1 | | | | | | | | 6 | | | |
| Mar.23,87' | 3 | | | | | | | | | | | |
| Mar.24,87' | | | | | | | | | | | | |
| Mar.26,87' | 2 | | | | | | | | | | | |
| Mar.27,87' | 1 | | | | | | | | | | | |
| Mar.31,87' | | | | | | | | | | | | |
| Apr.3,87' | 4 | | 1 | | | | | | 3 | | | |

Table 2.2.3.3.1

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-METHOD BLANK SUMMARY

| Analysis Date | Concentration(ug/L) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Methylene Chloride | Chloroform | Benzene | Toluene | Tetrachloro-ethylene | Ethyl Benzene | Xylenes | 1,4-DCB | Hexane | 1,1-Dichloro-ethene | BrCl2CH | Br2ClCH |
| Apr.10,87' | 20 | 3 | 2 | | | | | | | | | |
| Apr.14,87' | 3 | 2 | 1 | | | | | | | | | |
| Apr.15,87' | 3 | 3 | 4 | | | | | | | | | |
| May 1,87' | 9 | 1 | 1 | 1 | | | | | 1 | | | |
| May 2,87' | 1 | | 1 | 2 | | | | | | | | |
| May 4,87' | 4 | 1 | 1 | | | | | | 1 | | | |
| May 6,87' | 14 | 1 | 1 | | | | | | 2 | | | |
| May 10,87' | 19 | 7 | 5 | 2 | | | | | 7 | | 3 | |
| May 13,87' | 11 | | | | | | | | 7 | | | |
| May 17,87' | 10 | 12 | 11 | 3 | | | | | 10 | | 1 | |
| May 21,87' | 2 | | | | | | | | 1 | | | |
| May 25,87' | 18 | | 1 | 3 | | | | | 9 | | | |
| June 3,87' | 7 | | | 4 | | | | | 1 | | | |
| June 4,87' | 13 | | 1 | | | | | | 2 | | | |
| June 5,87' | 16 | | | 1 | | | | | 2 | | | |
| June 9,87' | 5 | | | 1 | | | | | 2 | | 2 | |
| June 11,87' | 10 | 4 | 2 | 2 | | | | | 1 | | 3 | 2 |
| June 12,87' | 12 | 3 | 4 | 2 | | | | | 2 | | 2 | 1 |
| June 13,87' | 17 | 1 | | | | | | | | | 2 | |
| June 14,87' | 10 | 3 | 2 | 1 | | | | | 3 | | 6 | 2 |
| June 15,87' | 7 | 3 | 2 | 2 | | | | | 2 | | 4 | 2 |
| June 16,87' | 4 | | | | | | | | | | 3 | |
| June 23,87' | 6 | | | 1 | | | | | | | | |
| June 24,87' | 2 | | | | | 1 | | | | | | |
| June 25,87' | 12 | | 1 | | | 1 | 13 | | | | | |
| July 7,87' | 34 | 3 | 3 | 3 | | | | | | | | |
| July 9,87' | 8 | 2 | 2 | 2 | | | | | 4 | | | |

Table 2.2.3.3.1

ZENON ENVIRONMENTAL INC.

VOLATILE ORGANIC COMPOUND-METHOD BLANK SUMMARY

| Analysis Date | Concentration(ug/L) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Methylene Chloride | Chloroform | Benzene | Toluene | Tetrachloro-ethylene | Ethyl Benzene | Xylenes | 1,4-DCB | Hexane | 1,1-Dichloro-ethene | BrCl2CH | Br2ClCH |
| July 13,87' | 12 | 7 | 5 | 3 | | | | | 60 | | | |
| July 14,87' | 7 | 2 | 4 | 4 | | | | | 5 | | | |
| July 17,87' | 5 | 3 | 3 | 2 | | | | | 4 | | | |
| July 21,87' | 7 | | | 1 | | | | | 3 | | | |
| July 21,87' | 6 | | | | | | | | | | | |
| July 23,87' | 5 | 1 | 1 | 2 | | | | | 3 | | | |
| July 24,87' | 3 | | | 1 | | | | | 1 | | | |
| July 27,87' | 11 | | | 1 | | | | | 3 | | | |
| July 28,87' | | | | | | | | | | | | |
| July 29,87' | 4 | 5 | 4 | 3 | | | | | 21 | | | |
| Aug.4,87' | 2 | | | | | | | | | | | |
| Aug.6,87' | | | | | | | | | | | | |
| Aug.10,87' | 1 | | | | | | | | 7 | | | |
| Aug.11,87' | 6 | | | | | | | | 19 | | | |
| Aug.12,87' | 2 | | | 2 | | | | | 1 | | | |
| Aug.14,87' | | 1 | 1 | 2 | | | | | 9 | | | |
| Aug.17,87' | 7 | | | | | | | | 5 | | | |
| Aug.18,87' | 9 | | | | | | | | 6 | | | |
| Aug.19,87' | 1 | | | | | | | | 9 | | | |
| | | | | | | | | | | | | |
| Average | 9 | 3 | 4 | 3 | 7 | 1 | 6 | 6 | 7 | 10 | 3 | 2 |
| S.D. | 6 | 3 | 3 | 5 | 8 | 0 | 7 | | 11 | | 1 | 0 |

* values are not included in the calculation of average and standard deviation
blank areas indicate concentrations < 1 ug/L

Table 2.2.3.3.1

## Distribution of Methylene Chloride in VOA Method Blanks

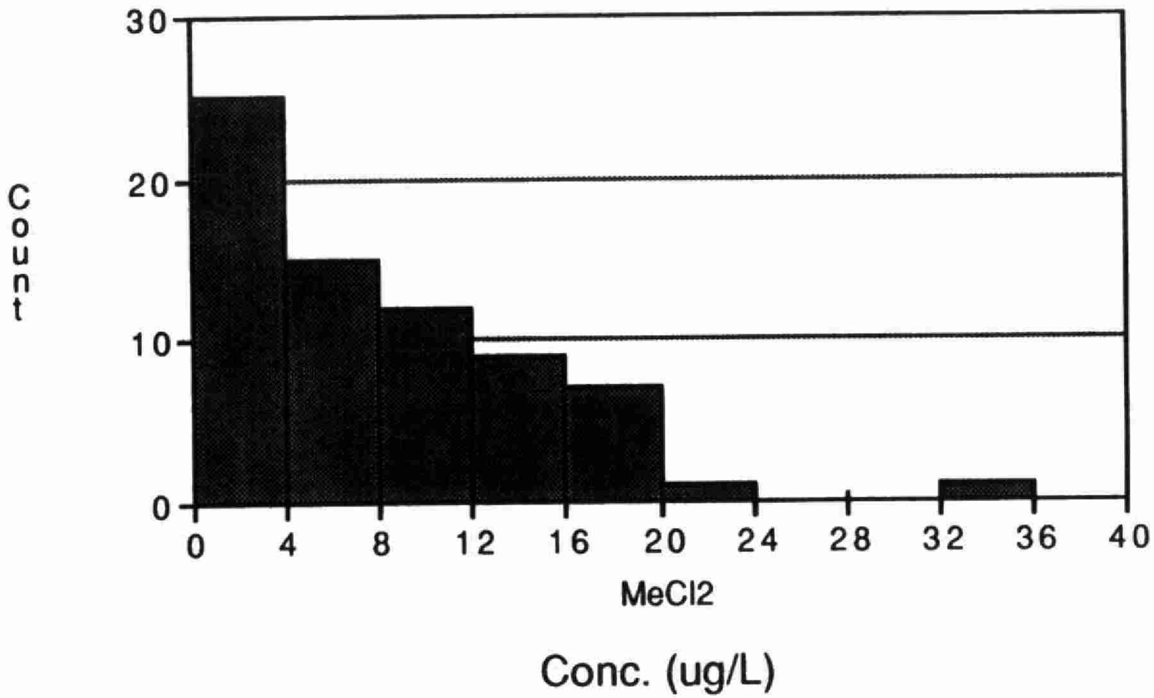
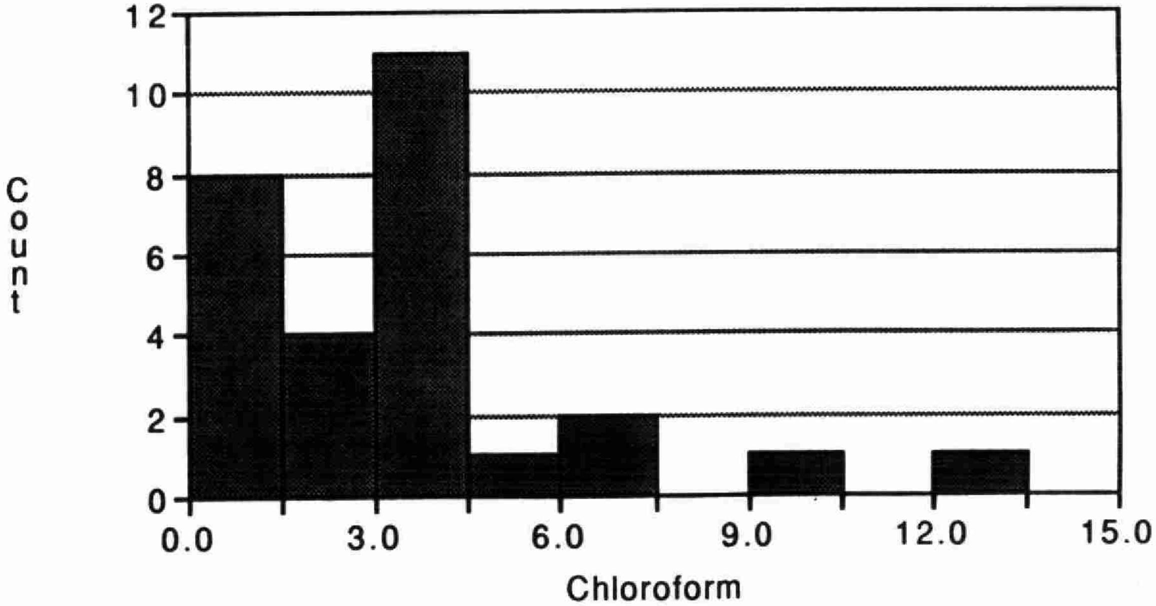



Fig. 2.2.3.3.1

## Distribution of Chloroform in VOA Method Blanks

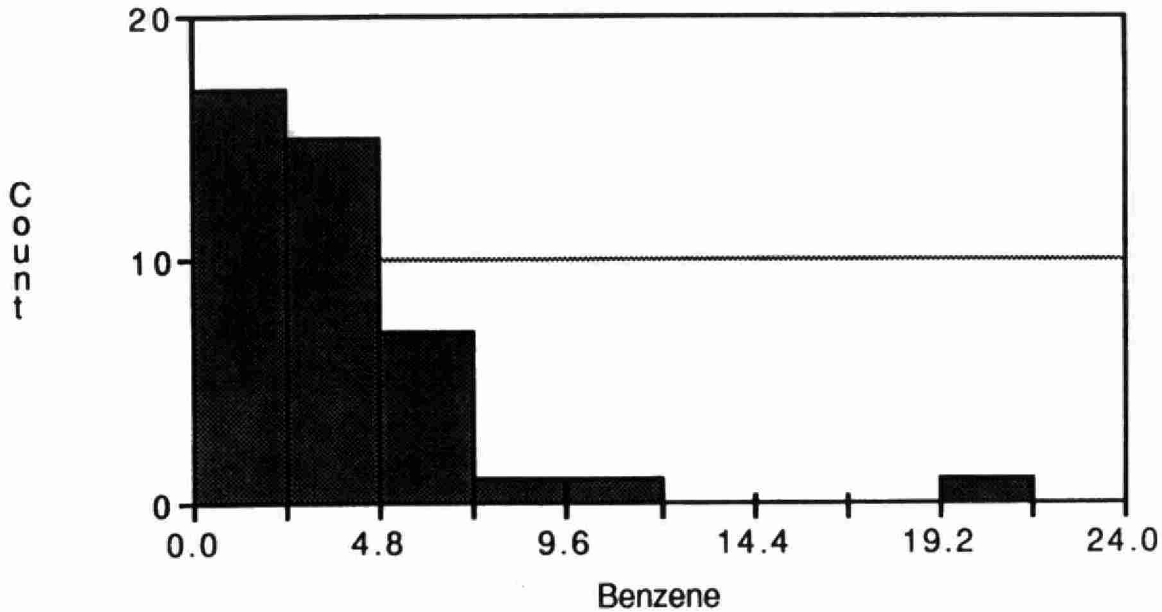



Conc. (ug/L)

Fig. 2.2.3.3.2

## Concentration Distribution of Benzene in VOA Method Blanks

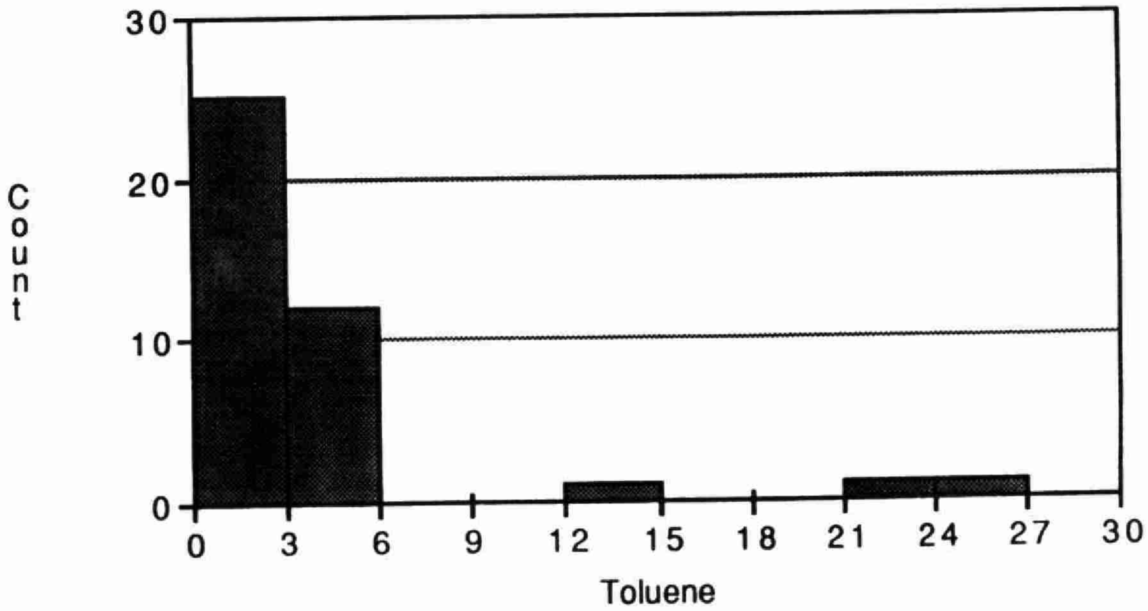





Conc. (ug/L)

Fig. 2.2.3.3.3

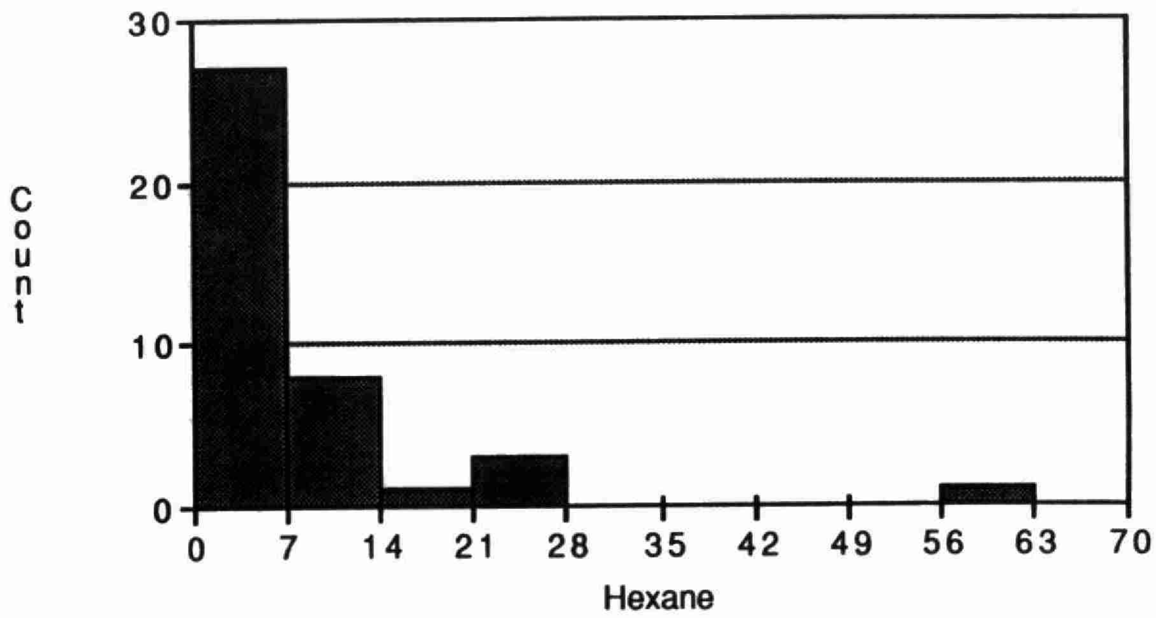
## Concentration Distribution of Toluene in VOA Method Blanks




Conc. (ug/L)

Fig. 2.2.3.3.4

## Distribution of Hexane in VOA Method Blanks




Conc. (ug/L)

Fig. 2.2.3.3.5

**Joint MOE/Environment Canada/MEA**
**Municipal Sewage Treatment Plants**
**Pilot Monitoring Project**
**Volume 3 - Appendices**

**Submitted to:**

**Ontario Ministry of the Environment**

**Prepared by:**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**January 1988**

**File: AN873095**
**Disk: MISA-MOE Report, A.K.Y.**

# APPENDIX 2.3

As provided by Enviroclean

# APPENDIX 2.4

## APPENDIX 2.4.1
## DETAILED ANALYTICAL METHOD FOR PCDD/PCDF

2.4.1.1 Extraction - Solids

Weighed portions of samples were transferred to glass thimbles and thoroughly mixed with $Na_2SO_4$ to remove water and improve extraction efficiency. Samples were spiked with 200 uL of 250 pg/ul $^{13}C_{12}$ 2,3,7,8-$T_4$CDD and 500 pg/ul $^{13}C_{12}$ $O_8$CDD. A plug of glass wool was inserted on the top of the thimble. The thimble was placed into a Soxhlet apparatus and the samples extracted overnight using toluene with a cycle rate of 10 - 15 minutes. The extracts were rotoevaporated to 2 - 3 mL and awaited additional clean up.

2.4.1.2 Extraction - Liquid

The volume of the sample was measured in a 1 L graduated cylinder and poured into a 2 L separatory funnel. 10 mL of methylene chloride was used to rinse the cylinder and this was transferred into the funnel, together with an additional 100 mL of methylene chloride. The sample was spiked with surogate standards, $^{13}C_{12}$-2,3,7,8-$T_4$CDD and $^{13}C_{12}$ $O_8$CDD to monitor recovery in the procedure.

The sample was shaken vigorously for 1 minute and when the phases had separated the methylene chloride extract was drained through a 1.5 inch anhydrous $Na_2SO_4$ column in an Allihn filter. The aqueous portion was re-extracted twice as above with 75 mL of methylene chloride. 20 mL of methylene chloride was used to wash the walls of the Allihn filter and suction was applied to recover all traces of the extract. The extract was then rotary evaporated to approximately 2 mL and then subjected to the clean-up procedure.

2.4.1.3 PCDD/DF Clean Up

The extracts described above were applied to a multi-column clean-up procedure.

The first column was a multilayer column of dimensions 40 cm x 24 cm ID carefully filled with the following: 1.0 g of silica (bottom layer), 2.0 g of 33% 1 M sodium hydroxide on silica, 2.0 g of silica and 1 cm sodium sulfate. Preparation of the adsorbents was performed as per the Dow methodology. The column was prewashed with 30 mL of hexane which was discarded. The sample extract was transferred to the column using a 1.0 mL syringe. The syringe was washed with two aliquots of 1.0 mL hexane which was also applied to the column. An additional 30 mL of hexane was then passed through the column. The total eluate was collected in a 250 mL flask. Isooctane was added to the eluate which was then concentrated to approximately 1 mL.

This extract was then applied to a 5 cm x 1 cm ID 10% $AgNO_3$ on silica gel column which had been prewet with 10 mL hexane. This adsorbent was also prepared as per the Dow methodology. The flask was rinsed with 2 x 2 mL hexane and applied to the column. A total of 20 mL hexane was then eluted through the column. The extract was solvent exchanged with isooctane and rotary evaporated to approximately 2 mL.

The concentrated eluate from the second column was then chromatographed on a 5 cm x 1.5 cm ID column of 1% water deactivated basic alumina. The column was prewashed with 20 mL hexane which was discarded. The concentrated isooctane eluate was introduced into the column followed by three 2 mL hexane rinses of the flask. The column was eluted with 12 mL of hexane and collected as fraction A.

The receiving flask was changed and the PCDD and PCDF were eluted from the column using 13 mL of 50% methylene chloride in hexane. This fraction was concentrated on a rotary evaporator to about 1 mL. This eluate was concentrated by blowing down with a gentle stream of nitrogen and transferred

with hexane rinses to a Reactivial. The extract was blown down to just dryness and then taken up in 25 uL of 250 pg/ul of triphenylene-$d_{12}$ in isooctane as an internal standard.

2.4.1.4 GC/MS Analysis

PCDD/PCDF Analysis

The elution windows for the analysis of PCDD/PCDF were established by the injection of a heavily contaminated municipal fly ash extract under MID conditions. This fly ash represents the closest approximation to the injection of a mixture of all possible tetra to octa chloro dibenzo(p)dioxins and dibenzofurans. Table 2-1 outlines the GC/MS conditions. A complete description detailing GC and MS instrumental conditions is found in the Appendix.

Quantification of PCDD/PCDF was performed according to external standard responses as follows:

| | | |
|---|---|---|
| TCDD | - | 2,3,7,8-$T_4$CDD |
| TCDF | - | 2,3,7,8-$T_4$CDF |
| $P_5$CDD | - | 1,2,3,7,8-$P_5$CDD |
| $P_5$CDF | - | 2,3,4,7,8-$P_5$CDF |
| $H_6$CDD | - | 1,2,34,7,8-$H_6$CDD |
| $H_6$CDF | - | 1,2,3,4,7,8-$H_6$CDF |
| $H_7$CDD | - | 1,2,34,6,7,8--$H_7$CDD |
| $H_7$CDF | - | 1,2,3,4,6,7,8-$H_7$CDF |
| $O_8$CDD | - | $O_8$CDD |
| $O_8$CDF | - | $O_8$CDF |

## INSTRUMENTAL CONDITIONS

### Gas Chromatography

| | |
|---|---|
| Injection Mode | - on column |
| Column Flow | - He @ 30 cm/sec. |
| Column | - 30 M x 0.32 mm DB-5 |

**Oven Temperature Profile**

100° - 2 min. -- 220° @ 16°/min.

220° -- 290° @ 12°/min. hold 10 min.

| | |
|---|---|
| GC/MS Interface | - direct couple |
| Transfer Area | - 270°C |

### Mass Spectrometry

| | |
|---|---|
| Ionization Mode | - electron impact |
| Electron Energy | - 70 eV |
| Filament Emission | - 0.5 A |
| Electron Multiplier | - 1600° V @ 5 x $10^6$ gain |
| Ionizer Temperature | - 170° |
| Scan | - stepped ion MID |

2.4.1.5 Criteria for Identification

The criteria for identification of PCDD/DF are found below:

1. Quantitation Ions and Ion Ratio Requirements

| **Parameter** | **Ions (m/z)** | **Ratio($M/M^{+2}$) or $M^{+2}/M^{+4}$** |
|---|---|---|
| $T_4CDD$ | 320, 322 | 0.77 ± .08 |
| 2,3,7,8-$T_4CDD^{13}C_{12}$ | 332, 334 | 0.77 ± .08 |
| $T_4CDF$ | 304, 306 | 0.77 ± .08 |
| $P_5CDD$ | 354, 356 | 0.60 ± .06 |
| $P_5CDF$ | 338, 340 | 0.60 ± .06 |
| $H_6CDD$ | 388, 390 | 0.49 ±.05 |
| $H_6CDF$ | 372, 374 | 0.49 ± .05 |
| $H_7CDD$ | 424, 426 | 1.05 ± .10 |
| $H_7CDF$ | 408, 410 | 1.05 ± .10 |
| $O_8CDD$ | 458, 460 | 0.93 ± .10 |
| $O_8CDF$ | 442, 444 | 0.93 ± .10 |
| $O_8CDD\ ^{13}C_{12}$ | 470, 472 | 0.93 ± .10 |

2. Retention Time and Response

i) Signal to noise ratio minimum of 3:1

ii) Specific isomer analyses - retention time within 1% window of external standard (OCDD/DF) or coelution with surrogate standard ($2,3,7,8-T_4CDD$, $O_8CDD$).

iii) Elution within retention window established by injection of heavily contaminated municipal fly ash.

## $T_4$CDD Surrogate Recovery
## (Comparison of Different Volumes)

Data File: PCDD/F-04-25/10uL

Independent Samples...

| Variable: | T4CDD-10uL | T4CDD-25uL |
|---|---|---|
| Mean: | 48.608 | 58.535 |
| Std. Deviation: | 27.879 | 26.876 |
| Observations: | 25 | 51 |

| | | |
|---|---|---|
| t-statistic: | -1.495 | Hypothesis: |
| Degrees of Freedom: | 74 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.139 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4$CDD surrogate standard recovery between a final volume of 10 uL and 25 uL

Table 2.4.1.1

## $O_8CDD$ Surrogate Recvoery
## (Comparison of Different Final Volumes)

Data File: PCDD/F-04-25/10uL

Independent Samples...

| Variable: | O8CDD-10uL | O8CDD-25uL |
|---|---|---|
| Mean: | 65.172 | 68.710 |
| Std. Deviation: | 29.371 | 25.412 |
| Observations: | 25 | 52 |

| | | |
|---|---|---|
| t-statistic: | -0.544 | Hypothesis: |
| Degrees of Freedom: | 75 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.588 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate recovery between a final volume of 10 uL and 25 uL

Table 2.4.1.2

Fig. 2.4.2.1 to Fig.2.4.2.10

UCL - Upper Control Limit (mean +3SD)

UWL - Upper Warning Limit (mean + 2SD)

LCL - Lower Control Limit (levels were set according to historical data)

∑ Tetra- CDF (m/z=306) INSTRUMENT RESPONSE CHART

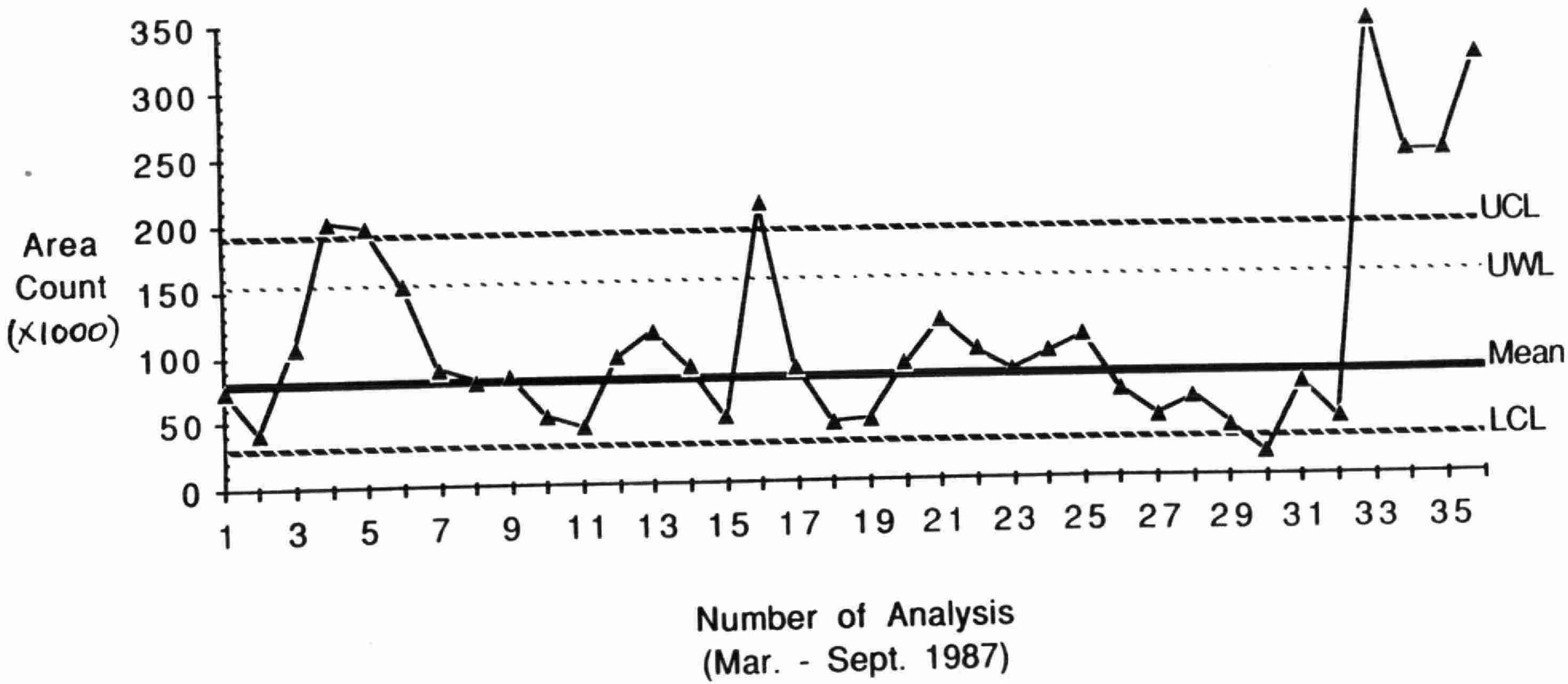


Fig.2.4.2.1

∑Tetra-CDD (m/z=322) INSTRUMENT RESPONSE CHART

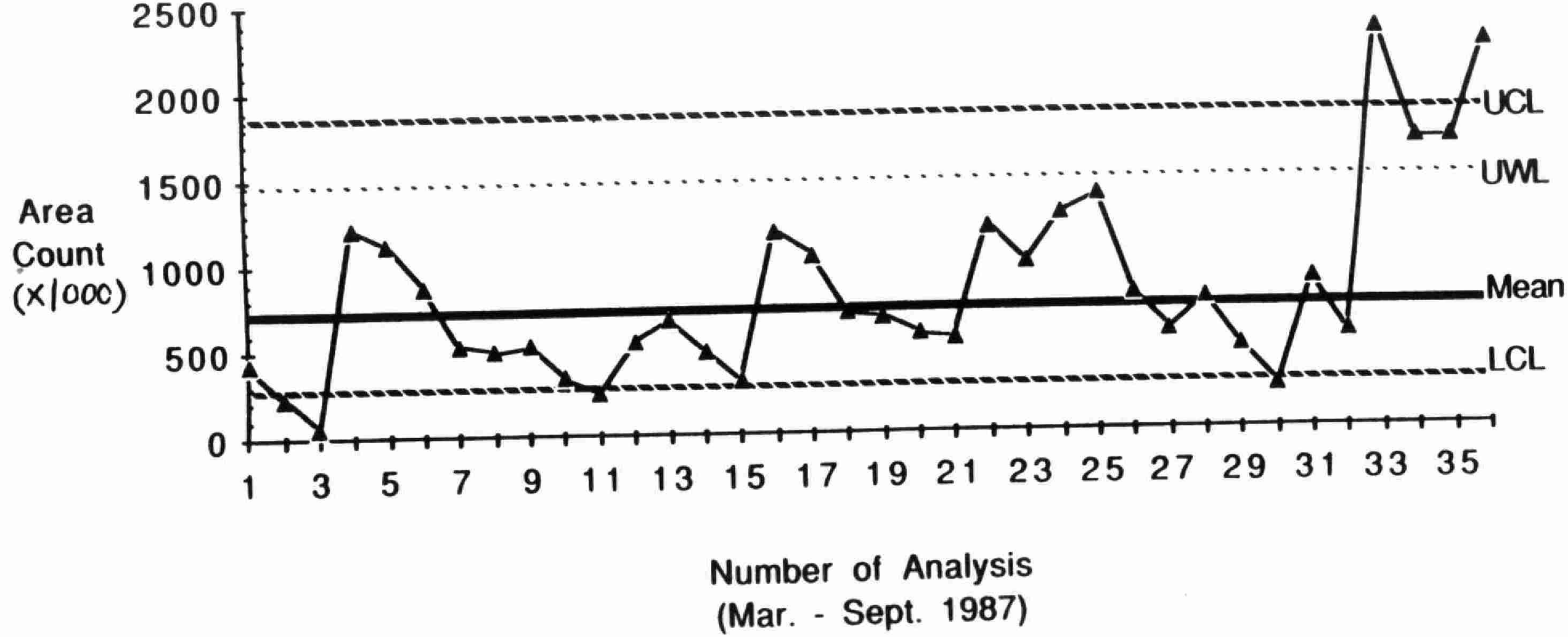


Fig.2.4.2.2

ΣPenta-CDF (m/z=340) INSTRUMENT RESPONSE CHART

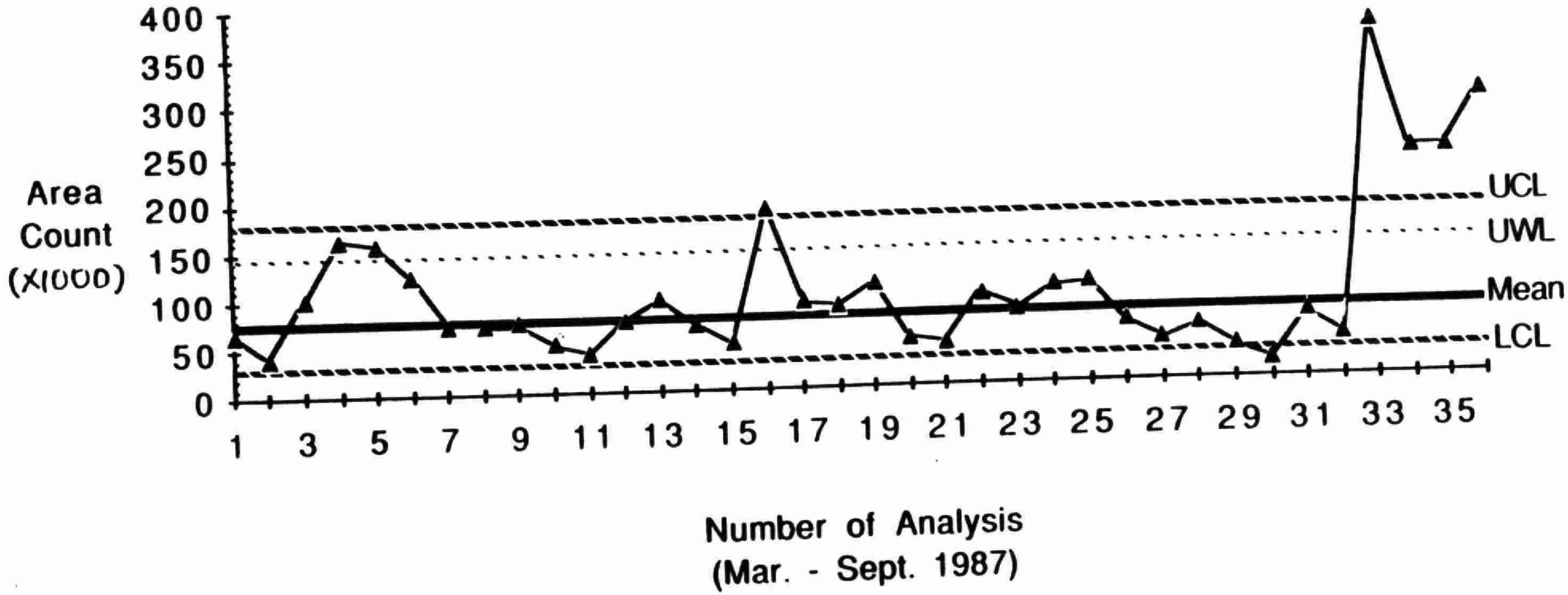


Fig.2.4.2.3

# ΣPenta-CDD (m/z=356) INSTRUMENT RESPONSE CHART

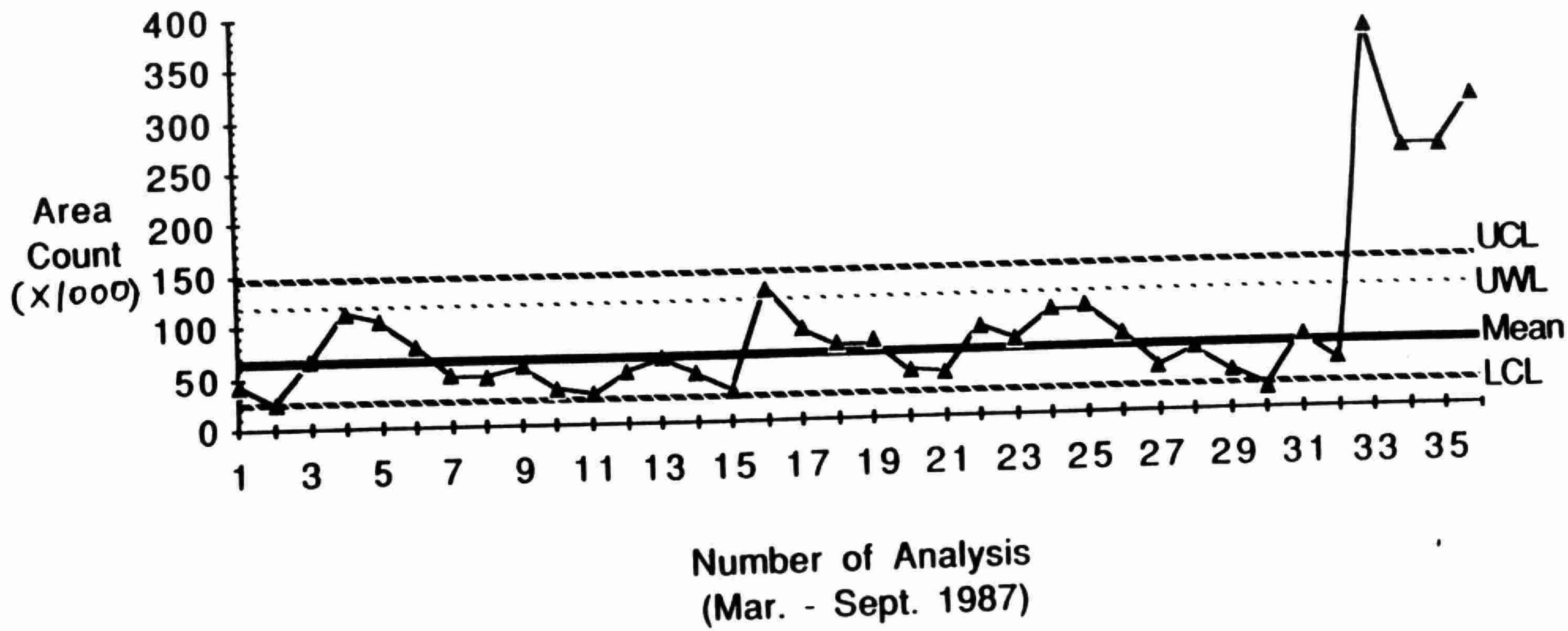


Fig.2.4.2.4

**ΣHexa-CDF (m/z=374) INSTRUMENT RESPONSE CHART**

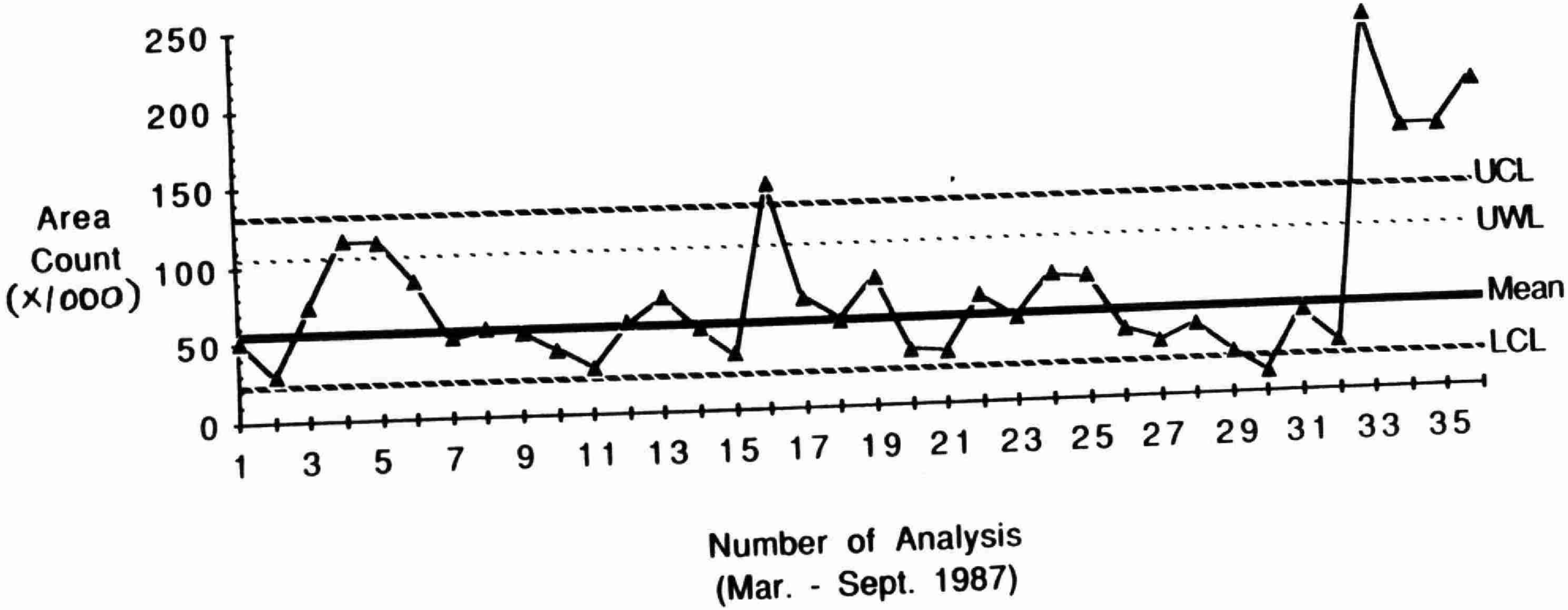


Fig.2.4.2.5

ΣHexa-CDD (m/z=390) INSTRUMENT RESPONSE CHART

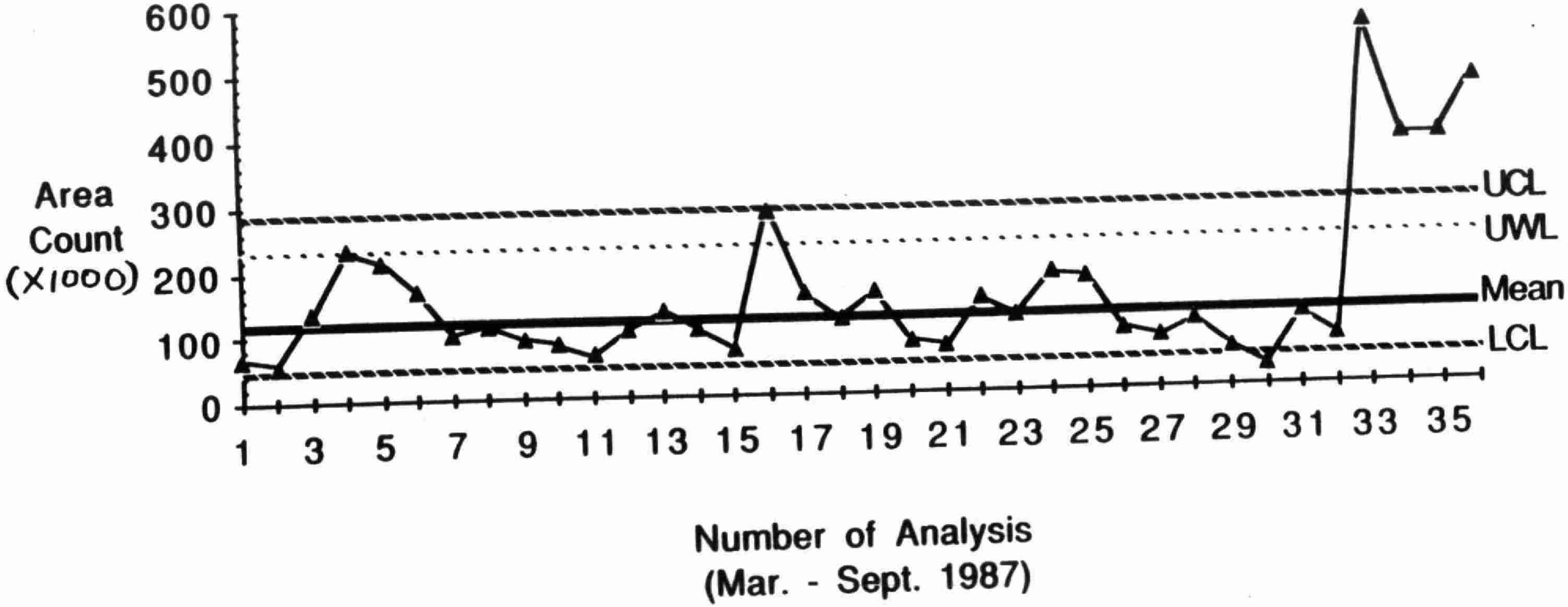


Fig.2.4.2.6

# ΣHepta-CDF (m/z=408) INSTRUMENT RESPONSE CHART

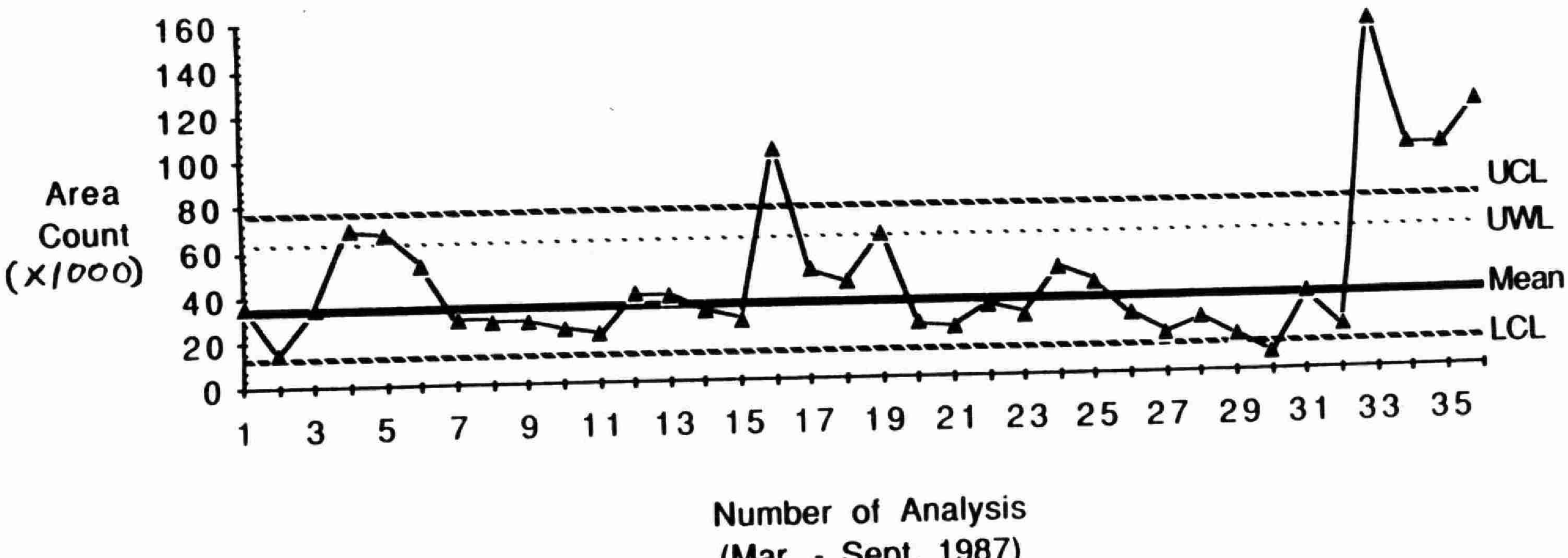


Fig.2.4.2.7

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# ΣHepta-CDD (m/z=424) INSTRUMENT RESPONSE CHART

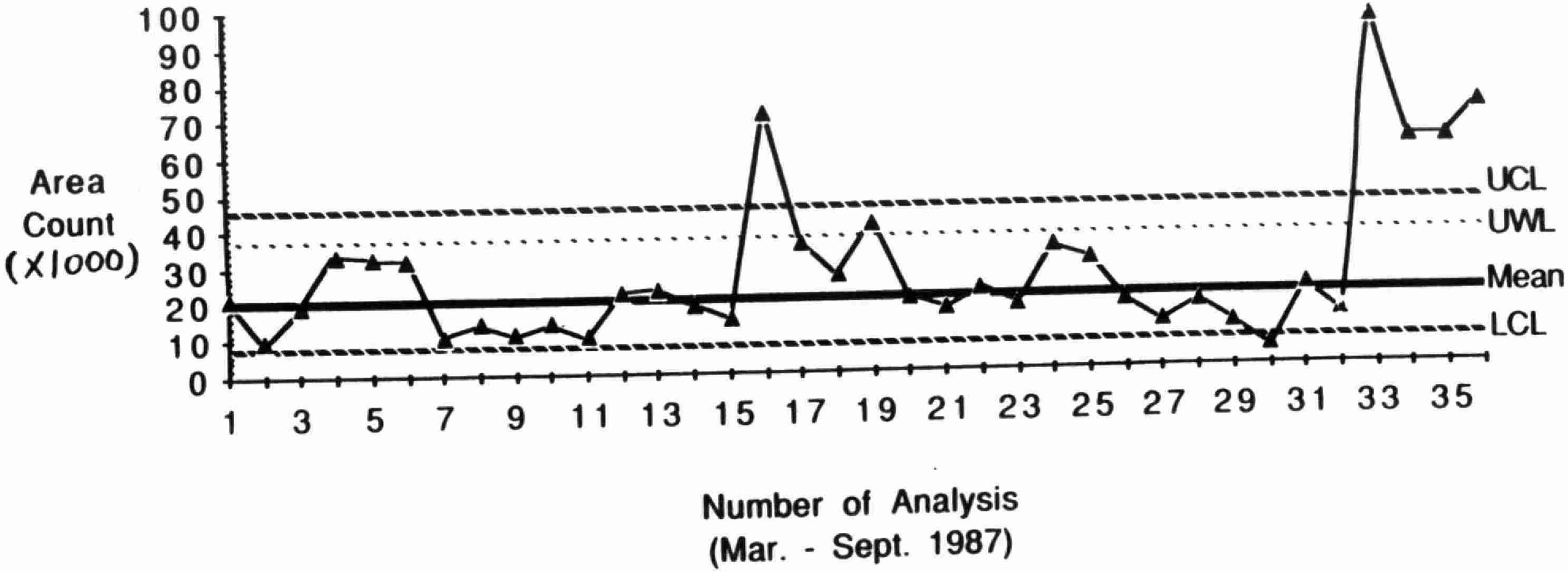



Fig.2.4.2.8

## ΣOcta-CDF (m/z=444) INSTRUMENT RESPONSE CHART

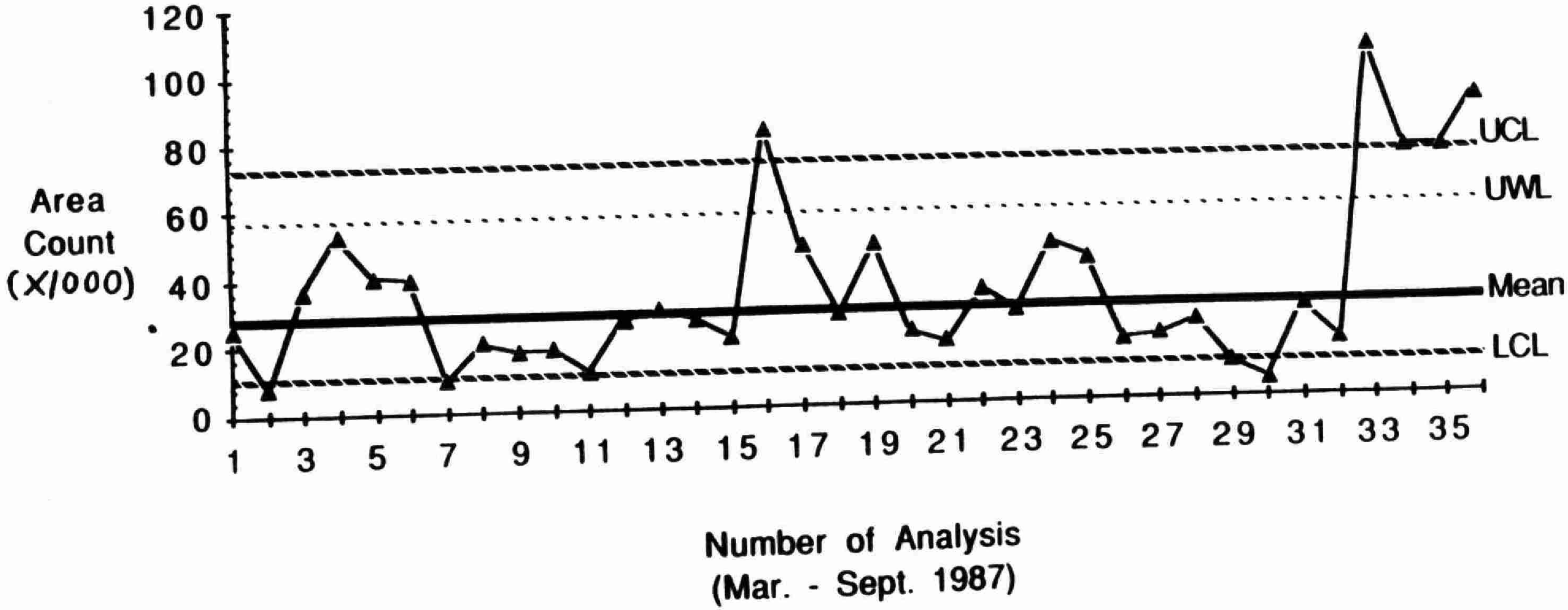



Fig.2.4.2.9

## ΣOcta-CDD (m/z=460) INSTRUMENT RESPONSE CHART

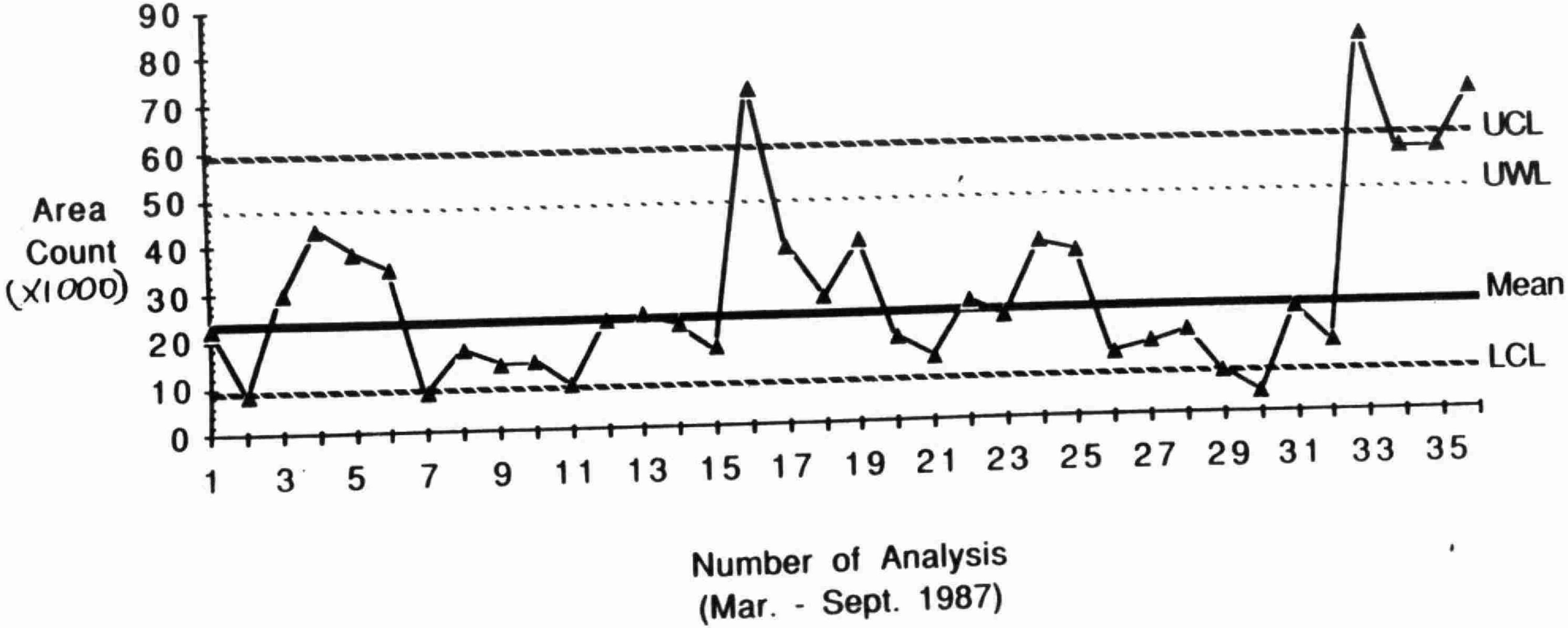



Fig.2.4.2.10

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | March-Sept/87 |
| Matrix Type | Primary Final Effluent | | |

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | ZE07-0064 | 71 | 57 |
| 2 | ZE09-0029 | 53.7 | 76 |
| 3 | ZE15-0008 | 65 | 72 |
| 4 | ZX22-0017 | 37 * | 45.7 |
| 5 | ZX24-0009 | 56 | 86.1 |
| 6 | ZX31-0014 | 100.5 | 119.4*# |
| 7 | ZX31-0014R | 52.1 | 64.7 |
| 8 | ZX31-0014RI | 51.1 | 49 |
| | | | |
| | | | |
| Average | | 60.8 | 64.5 |
| SD | | 18.9 | 14.7 |

QA / QC Action Limits for Surrogate Recovery : 40-110%

* outside the QA/QC action limts
# outliers (by Box-Whisker method), not included in the calculation of average & SD

Table 2.4.3.1.1

**ZENON ENVIRONMENTAL INC.**

**PCDD/F- SURROGATE RECOVERY SUMMARY**

Project ID: AN873095 Analyst OC/MM

Instrument GC/MS Analysis Date March-Sept.-1987

Matrix Type - Secondary Final Effluent

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | ZE05-0028 | 55 | 35 * |
| 2 | ZE05-0020 | 85 | 68 |
| 3 | ZE06-0008 | 42 | 27 * |
| 4 | ZE07-0031 | 13 * | 60 |
| 5 | ZE07-0048 | 13 * | 62 |
| 6 | ZE07-0057 | 15 * | 58 |
| 7 | ZE08-0011 | 15.9 * | 50 |
| 8 | ZE09-0010 | 46.3 | 85 |
| 9 | ZE09-0010R | 70.3 | 122.6 * |
| 10 | ZE09-0019 | 70.3 | 101 |
| 11 | ZE10-0010 | 77 | 86 |
| 12 | ZE11-0008 | 55 | 61 |
| 13 | ZE11-0014 | 57 | 83 |
| 14 | ZE12-0006 | 0 * # | 92 |
| 15 | ZE12-0016 • | 50 | 22.5 * |
| 16 | ZE13-0005 • | 97 | 59.1 |
| 17 | ZE13-0016 | 77 | 77 |
| 18 | ZE13-0024 | 58.1 | 21.6 * |
| 19 | ZE14-0004 | 58 | 91 |
| 20 | ZE14-0018 • | 8.8 * | 4.4 * |
| 21 | ZE14-0019 | 99 | 70 |
| 22 | ZE14-0019R | 57 | 108 |
| 23 | ZX18-0012 | 48 | 62 |
| 24 | ZX18-0016 | 79 | 73 |
| 25 | ZX18-0027 | 66 | 110 |
| 26 | ZX18-0027R | 52 | 93 |
| 27 | ZE20-0016 | 56 | 46 |
| 28 | ZX20-0017 | 54 | 42 |
| 29 | ZX21-0012 | 33 * | 39 * |
| 30 | ZX21-0012R | 34 * | 45 |
| 31 | ZX21-0017 | INT | 56 |
| 32 | ZX22-0025 | 34.8 * | 53.5 |
| 33 | ZX22-0025R | 42.2 * | 46.3 |
| 34 | ZX22-0034 | 41.4 | 47.3 |
| 35 | ZX22-0054 | 40.6 | 43.3 |
| 36 | ZX23-0021 • | 57.9 | 82.5 |
| 37 | ZX23-0021R | 127 * # | 86.6 |
| 38 | ZX23-0029 | 48.8 | 78.2 |



Table 2.4.3.1.2

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

Project ID: AN873095 | Analyst: OC/MM

Instrument: GC/MS | Analysis Date: March-Sept.-1987

Matrix Type - Secondary Final Effluent

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 39 | ZX25-0008 | 46.6 | 81.1 |
| 40 | ZX25-0008R | 44.6 | 85.6 |
| 41 | ZEX25-0016 | 61 | 58 |
| 42 | ZX26-0008 | 52.5 | 89 |
| 43 | ZX26-0008R | 54.9 | 73.4 |
| 44 | ZX27-0019 | 105 | 125 * |
| 45 | ZX28-0006 | 40 | 77 |
| 46 | ZX28-0022 | 49 | 52 |
| 47 | ZE29-0006 | 67 | 99 |
| 48 | ZE29-0006R | 78 | 95 |
| 49 | ZE29-0015 | 21.7 * | 10.4 * |
| 50 | ZE29-0023 | 42.5 | 26.6 |
| 51 | ZX31-0031 | 108 # | 114.3 * |
| 52 | ZX31-0049 | 18.1 * | 43.3 |
| | | | |
| | | | |
| Average | | 51.8 | 66.9 |
| SD | | 22.4 | 28.3 |

QA / QC Action Limits for Surrogate Recovery : 40-110%

* outside the QA/QC action limts

• sample was repeated

\# outlier (by Box-Whisker method), not included in the calculation of average & SD

Table 2.4.3.1.2

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | March-Sept.-1987 |

Matrix Type - Return Recycle

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | ZE07-0049 | 64 | 51 |
| 2 | ZE09-0020 | 56.3 | 89.5 |
| 3 | ZE07-0065 | INT | 75 |
| 4 | ZE09-0028 | 57.2 | 75.1 |
| 5 | ZE10-0011 | 67.6 | 62 |
| 6 | ZX22-0026 | 113 # | 92.2 |
| 7 | ZX22-0055 | 84.1 | 34 # |
| 8 | ZX28-0023 | 56 | 60 |
| 9 | ZX31-0015 | 54.4 | 49.4 |
| 10 | ZEX31-0048 | 32.9 | 28.3 |
| | | | |
| | | | |
| Average | | 59 .1 | 64 .7 |
| SD | | 14 .4 | 20 .5 |

QA/QC Action limits for surrogate recovery: 20-120%
INT-interference
# outlier( by Box-Whisker method), not included in the calculation of average and SD.

Table 2.4.3.1.3

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

Project ID: AN873095 Analyst OC/MM

Instrument GC/MS Analysis Date March-Sept.-1987

Matrix Type - Raw Sewage

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | ZE05-0033 | 86 | 84 |
| 2 | ZE06-0007 | 73 | 40 |
| 3 | ZE07-0030 | 12 * | 48 |
| 4 | ZE07-0030R | 17 * | 66 |
| 5 | ZE07-0063 | 55 | 58 |
| 6 | ZE07-0047 | 22 | 61 |
| 7 | ZE08-0010 | 17* | 27.7 |
| 8 | ZE09-0009 | 89 | 85.4 |
| 9 | ZE09-0018 | 62 | 94.4 |
| 10 | ZE09-0027 | iNT | 21.5 |
| 11 | ZE06-0005 | 65 | 43 |
| 12 | ZE06-0005R | 81 | 47 |
| 13 | ZE10-0009 | 88.6 | 85.4 |
| 14 | ZE11-0013 | 66 | 86.1 |
| 15 | ZE12-0005 | 50 | 61.9 |
| 16 | ZE12-0015 • | 74 | 43.5 |
| 17 | ZE13-0006 | 23 | 46.3 |
| 18 | ZE13-0015 | 97 | 138 |
| 19 | ZE13-0023 | 53 | 74.8 |
| 20 | ZE14-0003 | 58 | 75.9 |
| 21 | ZE14-0017 • | 36 | 39.9 |
| 22 | ZE15-0007 | 17 * | 81.2 |
| 23 | ZX18-0011 | 46 | 56 |
| 24 | ZX18-0015 | 73 | 85 |
| 25 | ZX18-0026 | 54 | 69 |
| 26 | ZX20-0015 | 45 | 61 |
| 27 | ZX21-0011 • | 0 * | 0 * |
| 28 | ZX21-0016 | 42 | 55 |
| 29 | ZX22-0016 | 12.7 * | 24 |
| 30 | ZX22-0024 | 39.3 | 46.7 |
| 31 | ZX22-0033 | 84.7 | 56.9 |
| 32 | ZX22-0053 | 79.8 | 50.8 |
| 33 | ZX23-0020 | 57.9 | 82.5 |
| 34 | ZX23-0028 | 73.1 | 64.6 |
| 35 | ZX23-0028R | 73.1 | 64.6 |
| 36 | ZX25-0007 | 39.7 | 94.4 |
| 37 | ZX25-0015 | 68.4 | 84.3 |

Table 2.4.3.1.4

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | March-Sept.-1987 |

Matrix Type - Raw Sewage

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 38 | ZX26-0007 | 116 | 84.1 |
| 39 | ZX27-0018 | 78 | 83 |
| 40 | ZX28-0005 | 55 | 37 |
| 41 | ZX28-0021 | 62 | 51 |
| 42 | ZX28-0021R | 104 | 106 |
| 43 | ZX29-0005 | 82 | 94 |
| 44 | ZX29-0014 | 72 | 94 |
| 45 | ZX30-0005 | INT | 58 |
| 46 | ZX31-0013 | 6 * | 34.8 |
| 47 | ZX31-0030 | 47.2 | 39.9 |
| 48 | ZX31-0047 | 35.6 | 42.7 |
| | | | |
| | | | |
| Average | | 56.3 | 63.1 |
| SD | | 27.5 | 25.4 |

INT-Interference
* outside the QA/QC action limits
• sample was repeated

Table 2.4.3.1.4

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

Project ID: AN873095 Analyst OC/MM

Instrument GC/MS Analysis Date March-Sept.-1987

Matrix Type - Sludge

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | ZE05-0017 | 87 | 66 |
| 2 | ZE05-0018 | 100 | 80 |
| 3 | ZE05-0025 | 91 | 46 |
| 4 | ZE05-0026 | 101 | 131* |
| 5 | ZE06-0006 | 85 | 108 |
| 6 | ZE07-0028 | 75 | 98 |
| 7 | ZE07-0029 | 69 | 93 |
| 8 | ZE07-0050 | 50 | 80 |
| 9 | ZE07-0051 | 44 | 45 |
| 10 | ZE07-0054 | 86 | 81 |
| 11 | ZE07-0055 | 42 | 64 |
| 12 | ZE07-0061 | 71 | 47 |
| 13 | ZE07-0062 | 110 | 45 |
| 14 | ZE07-0065 | INT | 75 |
| 15 | ZE08-0007 | 53 | 63.8 |
| 16 | ZE08-0008 | 18.5 * | 25.2 |
| 17 | ZE08-0009 | 59.9 | 58.4 |
| 18 | ZE09-0008 | 95.7 | 91 |
| 19 | ZE09-0016 | 39.2 | 56.2 |
| 20 | ZE09-0017 | 55.3 | 50.9 |
| 21 | ZE09-0025 | 121 * | 92.8 |
| 22 | ZE09-0026 | INT | 87 |
| 23 | ZE09-0032 | 49.7 | 70.9 |
| 24 | ZE09-0033 | INT | 59 |
| 25 | ZE11-0005 | 80 | 59.1 |
| 26 | ZE11-0006 | 0 * | 134 * |
| 27 | ZE11-0015 | INT. | 68.8 |
| 28 | ZE11-0016 | INT. | 38.3 |
| 29 | ZE12-0007 | 71.4 | 71.0 |
| 30 | ZE12-0008 | 29.4 | 23.7 |
| 31 | ZE12-0017 • | 84 | 47.4 |
| 32 | ZE12-0018 | 55 | 56.6 |
| 33 | ZE13-0007 | 82 | 74.8 |
| 34 | ZE13-0008 | 96 | 90.5 |
| 35 | ZE13-0013 | 80 | 67.1 |
| 36 | ZE13-0021 | 29.5 | 49.6 |
| 37 | ZE13-0022 | 20.7 | 45.6 |
| 38 | ZE14-0005 | 33.6 | 37.8 |

Table 2.4.3.1.5

**ZENON ENVIRONMENTAL INC.**

**PCDD/F- SURROGATE RECOVERY SUMMARY**

Project ID: AN873095 Analyst OC/MM

Instrument GC/MS Analysis Date March-Sept.-1987

Matrix Type - Sludge

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 39 | ZE14-0006 | 41.8 | 29.5 |
| 40 | ZE14-0015 | 159.9* | 111.2 |
| 41 | ZE14-0016 | 75.9 | 39.4 |
| 42 | ZE15-0005 | 81.5 | 56.3 |
| 43 | ZE15-0006 • | 0* | 75.5 |
| 44 | ZE15-0013 | 50.6 | 16.2 * |
| 45 | ZE15-0014 • | INT. | 95.7 |
| 46 | ZX18-0017 | 120 | 65 |
| 47 | ZX18-0018 | 130 * | 67 |
| 48 | ZX18-0024 | 100 | 79 |
| 49 | ZX18-0025 | INT. | 82 |
| 50 | Z20-0018 | 105 | INT. |
| 51 | Z20-0019 | 45 | 41 |
| 52 | ZEX21-0009 | 60 | 52 |
| 53 | ZEX21-0010 | 34 | 43 |
| 54 | ZEX21-0015 | 79 | 74 |
| 55 | ZEX22-0014 | 42 | 46.8 |
| 56 | ZEX22-0015 | 50 | 44.4 |
| 57 | ZEX22-0027 | 120 | 79.8 |
| 58 | ZEX22-0031 | 48.2 | 49.6 |
| 59 | ZEX22-0032 | INT. | 14.2 * |
| 60 | ZEX22-0051 | 34.2 | 33.6 |
| 61 | ZEX23-0022 | 86.8 | 73.2 |
| 62 | ZEX23-0023 | 72.7 | 71.9 |
| 63 | ZEX24-0006 | 149 * | 116 |
| 64 | ZEX25-0005 | 39.7 | 94.4 |
| 65 | ZEX25-0006 | 127 * | 79 |
| 66 | ZEX25-0006R | INT | 72 |
| 67 | ZEX25-0013 | 150 * | 130 * |
| 68 | ZEX26-0006 | INT | 80.9 |
| 69 | ZEX27-0006 | 43 | 71 |
| 70 | ZEX27-0007 | 91 | 77 |
| 71 | ZEX27-0016 | 119 | 99 |
| 72 | ZEX27-0017 | 116 | 105 |
| 73 | ZEX28-0008 | INT | 108 |
| 74 | ZEX28-0020 • | 142 * | 128 * |
| 75 | ZEX29-0007 | 85 | 94 |
| 76 | ZEX29-0008 | 92 | 96 |

**Table 2.4.3.1.5**

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

Project ID: AN873095    Analyst: OC/MM

Instrument: GC/MS    Analysis Date: March-Sept.-1987

Matrix Type - Sludge

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 77 | ZEX29-0013 | 70 | 64 |
| 78 | ZEX29-0020 | 94 | 131 * |
| 79 | ZEX30-0007 | 110 | 67 |
| 80 | ZEX30-0008 | INT | 115 |
| 81 | ZEX31-0016 | 84.8 | 46.4 |
| 82 | ZEX31-0017 | 89.1 | 110.8 |
| 83 | ZEX31-0032 | 154.2 * | 108.5 |
| 84 | ZEX31-0044 | 80.7 | 86.1 |
| 85 | ZEX31-0045 | 113.3 | 96.3 |
| 86 | ZEX31-0046 | 146.2 * | 51.5 |
| | | | |
| Average | | 78.3 | 72.3 |
| SD | | 36.8 | 27.9 |

QA / QC Action Limits for Surrogate Recovery: 20-120%
* outside the QA/QC action limits
• sample was repeated
INT-Interference

Table 2.4.3.1.5

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

Project ID: AN873095

Instrument: GC/MS | Analyst: OC/MM

Matrix Type: Glassware rinse | Analysis Date: March-Sept/87

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | Sep.Blk.1 | 65 | 60 |
| 2 | Sox.Blk.1 | 56 | 70 |
| 3 | Sep. Blk.2 | 76.7 | 108.2 |
| 4 | Sox Blk.2 | 82.5 | 171.9 * # |
| 5 | Sep. Blk.3 | 40 | 60 |
| 6 | Sox. Blk.3 | 88.4 | 82.5 |
| 7 | Sep Blk.4 | 23 * | 47 |
| 8 | Sox Blk.4 | 17 * | 67 |
| 9 | Sep Blk.5 | 57 | 78 |
| 10 | Sox. Blk.5 | 83 | 67 |
| 11 | Sep Blk.6 | 30* | 45 |
| 12 | Sox. Blk.6 | 28* | 50.5 |
| 13 | Sep. Blk.7 | 101 | 84.7 |
| 14 | Sox. Blk.7 | 82.3 | 76.3 |
| 15 | Sep. Blk.8 | 24 * | 51.9 |
| 16 | Sox. Blk.8 | 38.9 * | 121 * |
| 17 | Sep. Blk.9 | 37 * | 98.3 |
| 18 | Sox. Blk.9 | 55.1 | 36* |
| 19 | Sep. Blk.10 | 83 | 61 |
| 20 | Sox. Blk.10 | 55 | 43 |
| 21 | Sep. Blk.11 | 124 * | 73 |
| 22 | Sox. Blk.11 | 35 * | 30 * |
| 23 | Sep. Blk.12 | 25 * | 21 * |
| 24 | Sox. Blk.12 | 47 | 76.5 |
| | | | |
| | | | |
| Average | | 56.4 | 65.6 |
| SD | | 28.4 | 24.3 |

QA / QC Action Limits for Surrogate Recovery : 40-110%

* outside the QA/QC action limts

# outlier (by Box-Whisker method), not included in the calculation of average & SD

Table 2.4.3.1.6

ZENON ENVIRONMENTAL INC.

PCDD/F- SURROGATE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC/MM |
| Instrument | GC/MS | Analysis Date | March-Sept/87 |
| Matrix Type | Native Spike | | |

| No | Zenon Sample I.D. | Surrogate #1 13C12-T4CDD % Rec. | Surrogate #2 13C12-O8CDD % Rec. |
|---|---|---|---|
| 1 | March 10/87 | 0 * | 25 * |
| 2 | March 20/87 | 53 | 50 |
| 3 | March 31/87 | 5 * | 11 * |
| 4 | April 7/87 | 48.9 | 54 |
| 5 | April 24/87 | 21.6 * | 19.6 * |
| 6 | May 2/87 | 56 | 78 |
| 7 | May 17/87 | 42 | 41 |
| 8 | May 25/87 | 38 * | 60 |
| 9 | June 2/87 | 41 | 51 |
| 10 | July 21/87 | 53 | 59 |
| 11 | August 6/87 | 35 * | 86 |
| 12 | Sept. 2/87 | 46.6 | 49.1 |
| | | | |
| | | | |
| Average | | 36.7 | 48.6 |
| SD | | 18.5 | 22.2 |

QA / QC Action Limits for Surrogate Recovery : 40-110%

* outside the QA/QC action limts

Table 2.4.3.1.7

**13C12-T4CDD SURROGATE RECOVERY**
**(Primary Final Effluent)**

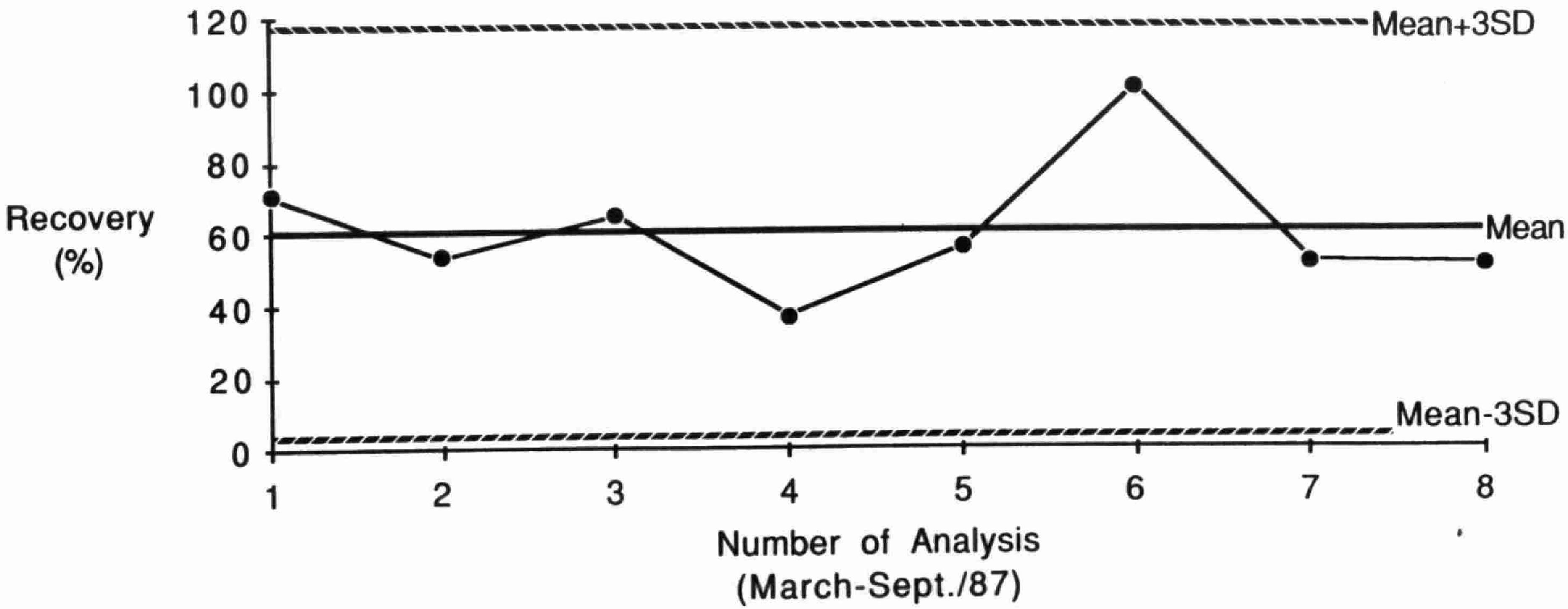



Fig. 2.4.3.1.1

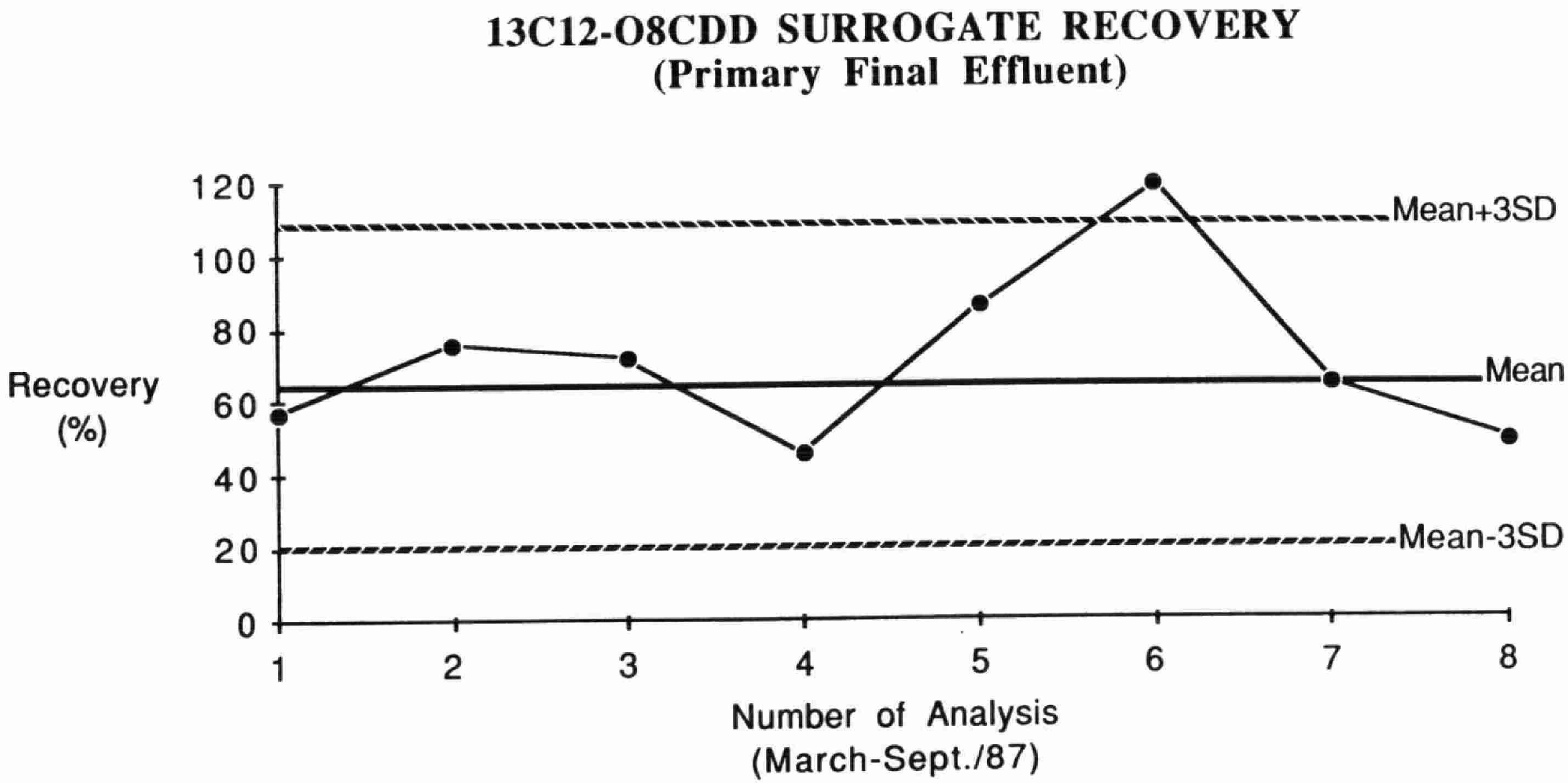

13C12-O8CDD SURROGATE RECOVERY
(Primary Final Effluent)
120
100
80
60
40
20
0
Recovery
(%)
Mean+3SD
Mean
Mean-3SD
1
2
3
4
5
6
7
8
Number of Analysis
(March-Sept./87)

Fig. 2.4.3.1.2

**PCDD/F Surrogate Recovery**
**Box-Whisker Method**
**(Primary Final Effluent)**

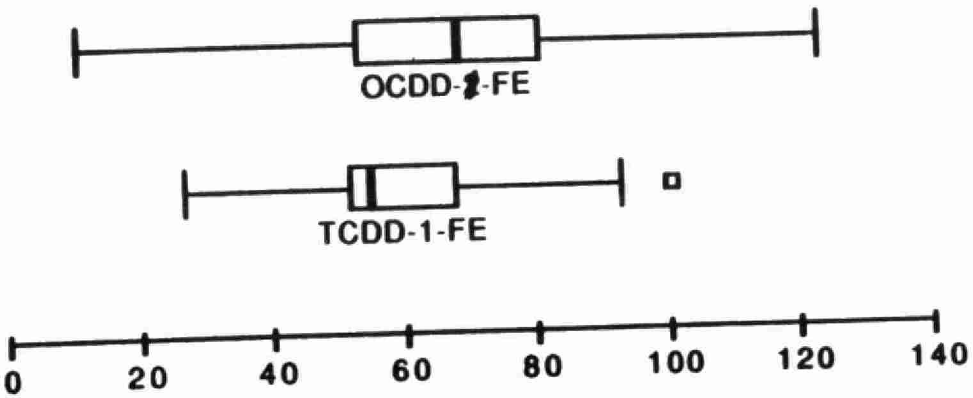



Fig. 2.4.3.1.3

**13C12-T4CDD SURROGATE RECOVERY**
**(Secondary Final Effluent )**

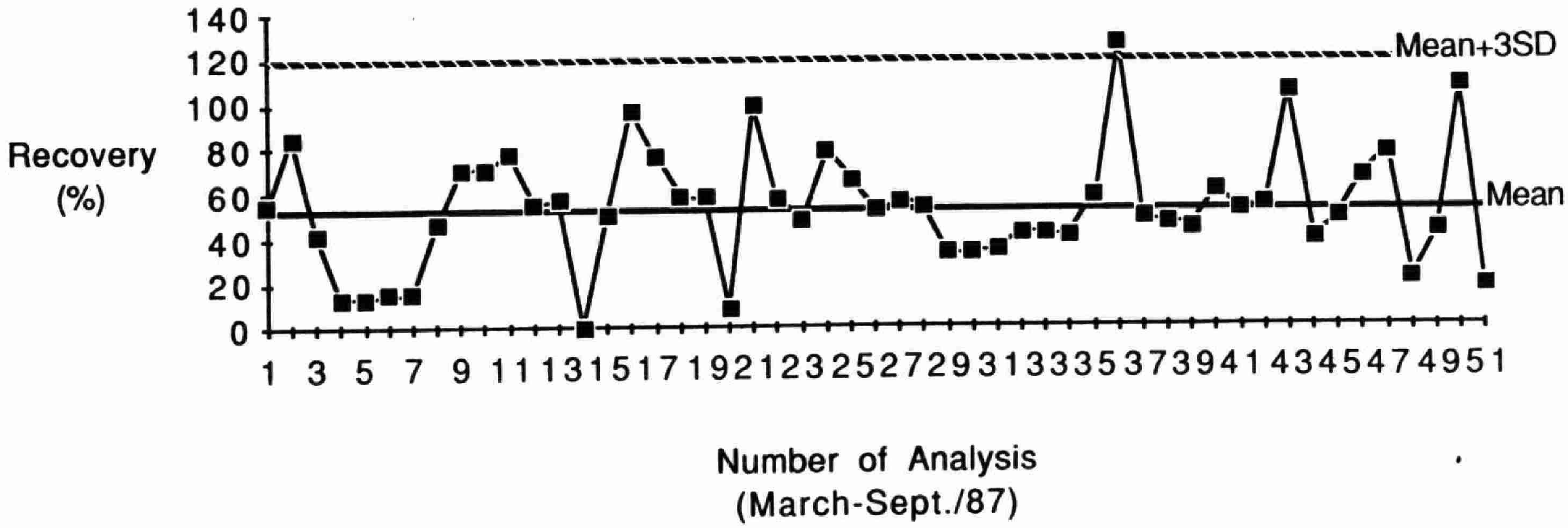



Fig. 2.4.3.1.4

## 13C12-O8CDD SURROGATE RECOVERY
## (Secondary Final Effluent )

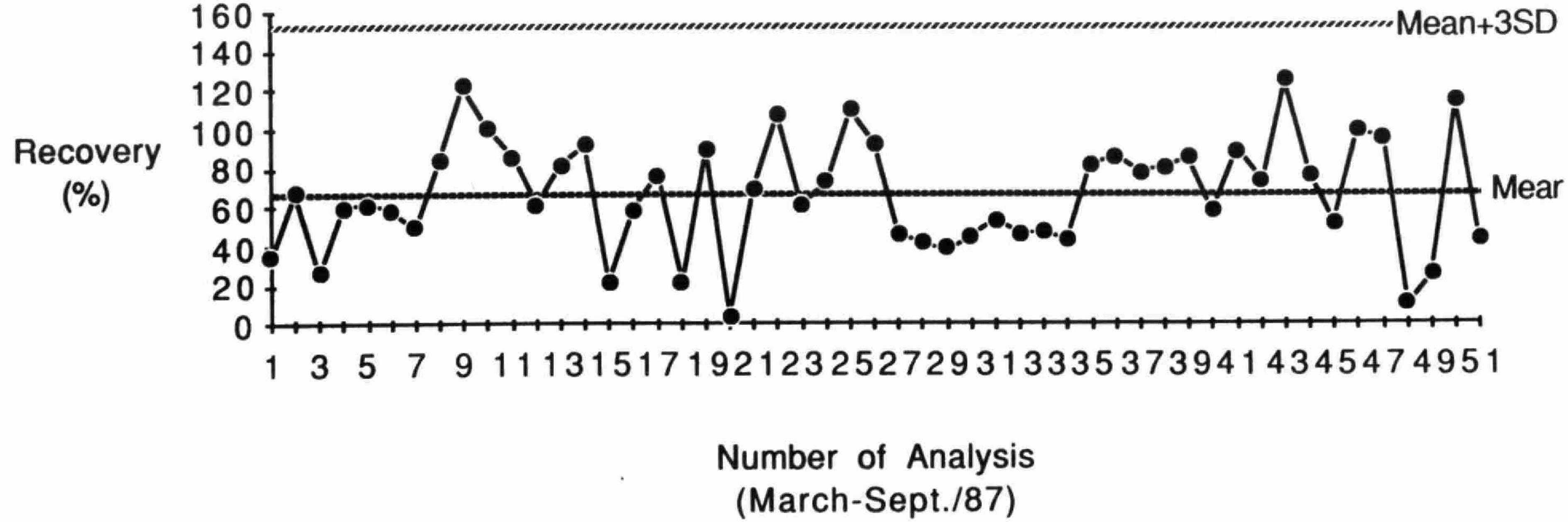



Fig. 2.4.3.1.5

**PCDD/F Surrogate Recovery**
**Box-Whisker Method**
**(Secondary Final Effluent)**

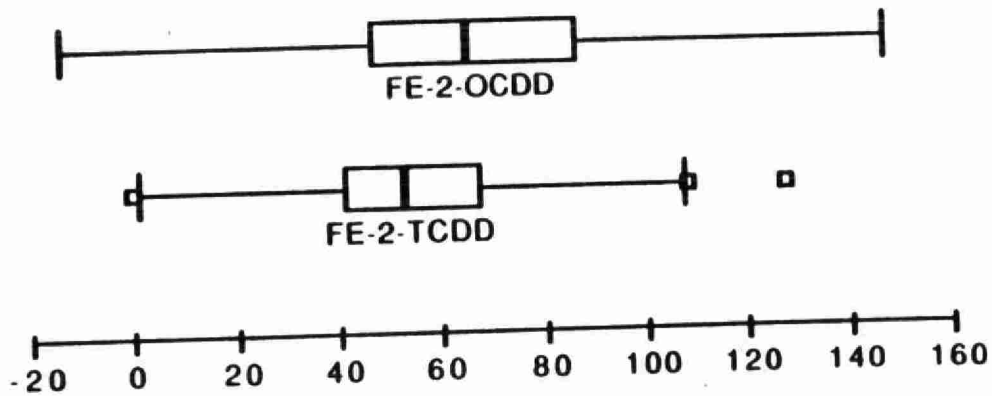



Fig. 2.4.3.1.6

# 13C12-T4CDD SURROGATE RECOVERY
## (Return Recycle)

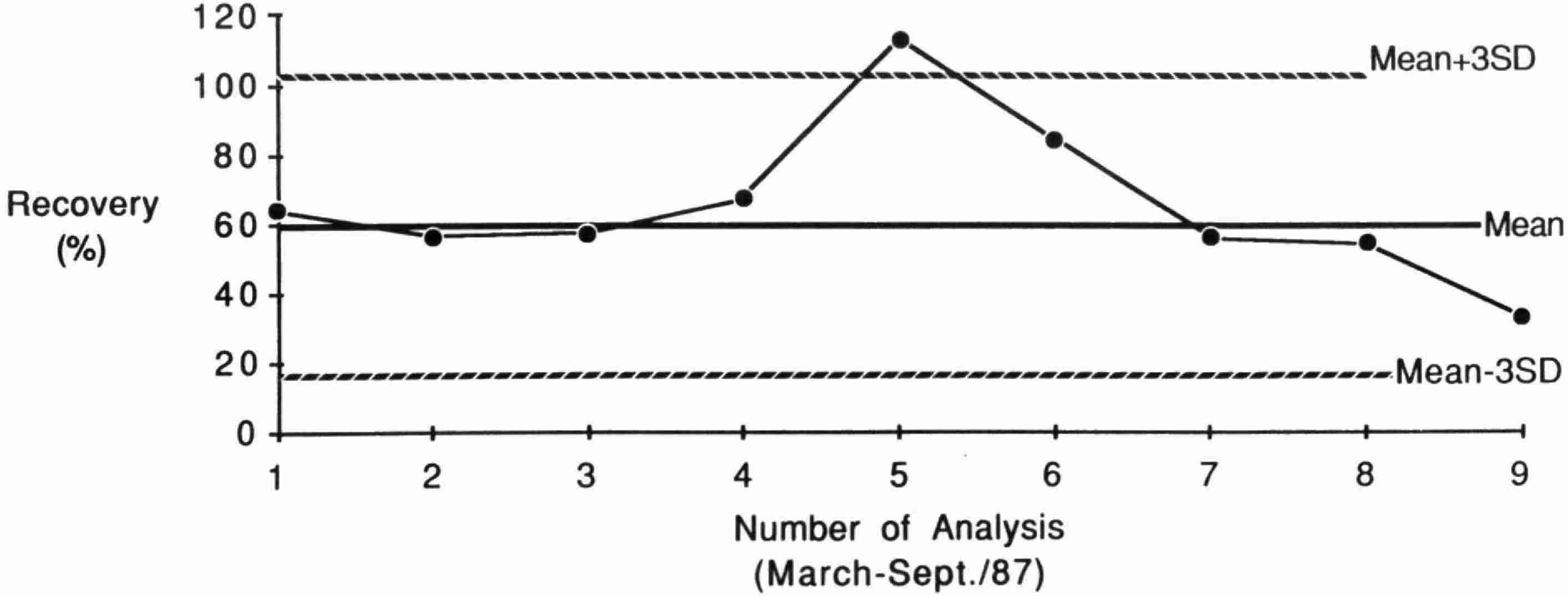



Fig. 2.4.3.1.7

## 13C12-O8CDD SURROGATE RECOVERY
(Return Recycle)

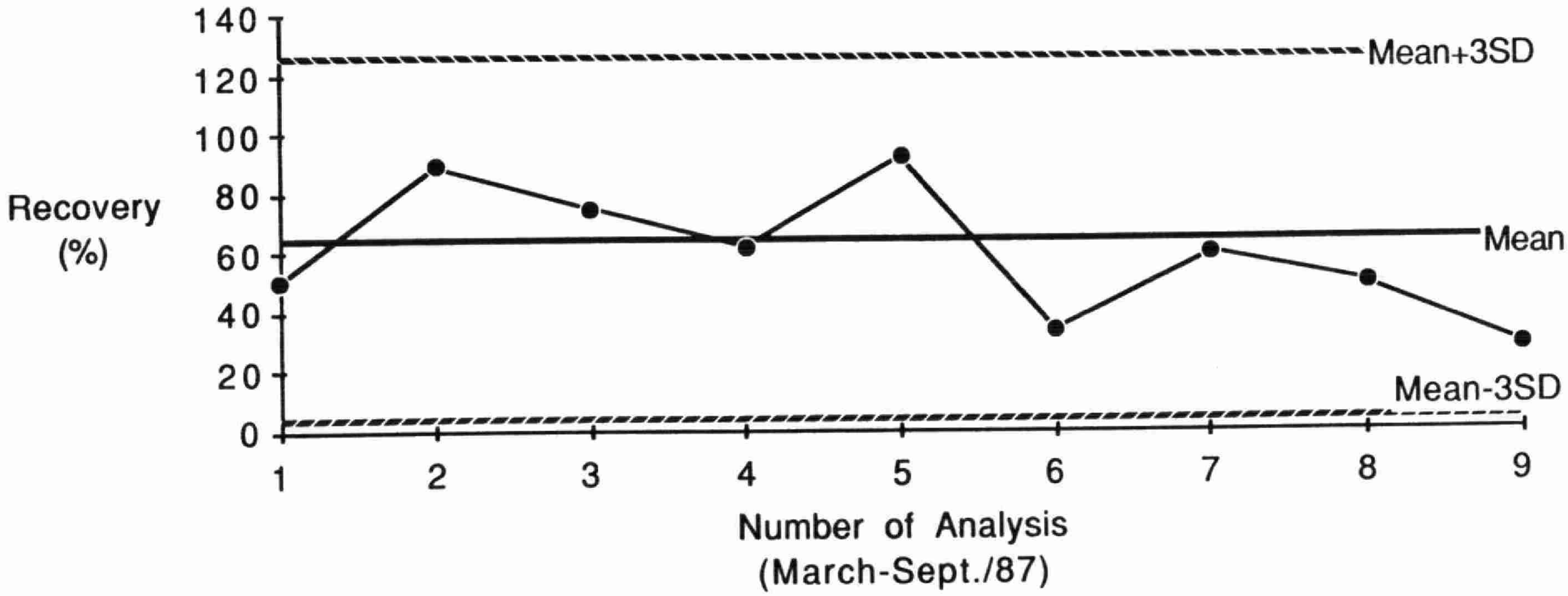



Fig. 2.4.3.1.8

**PCDD/F Surrogate Recovery**
**Box-Whisker Method**
**(Return Recycle)**

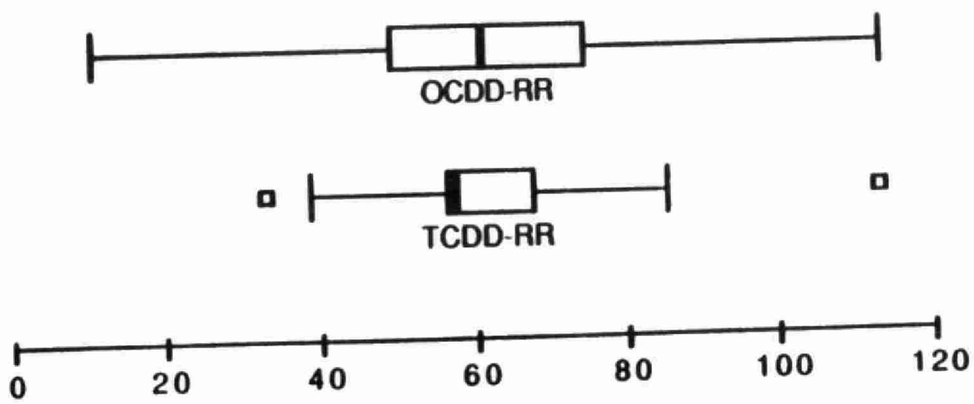



Fig. 2.4.3.1.9

## 13C12-T4CDD SURROGATE RECOVERY
## (Raw Sewage)

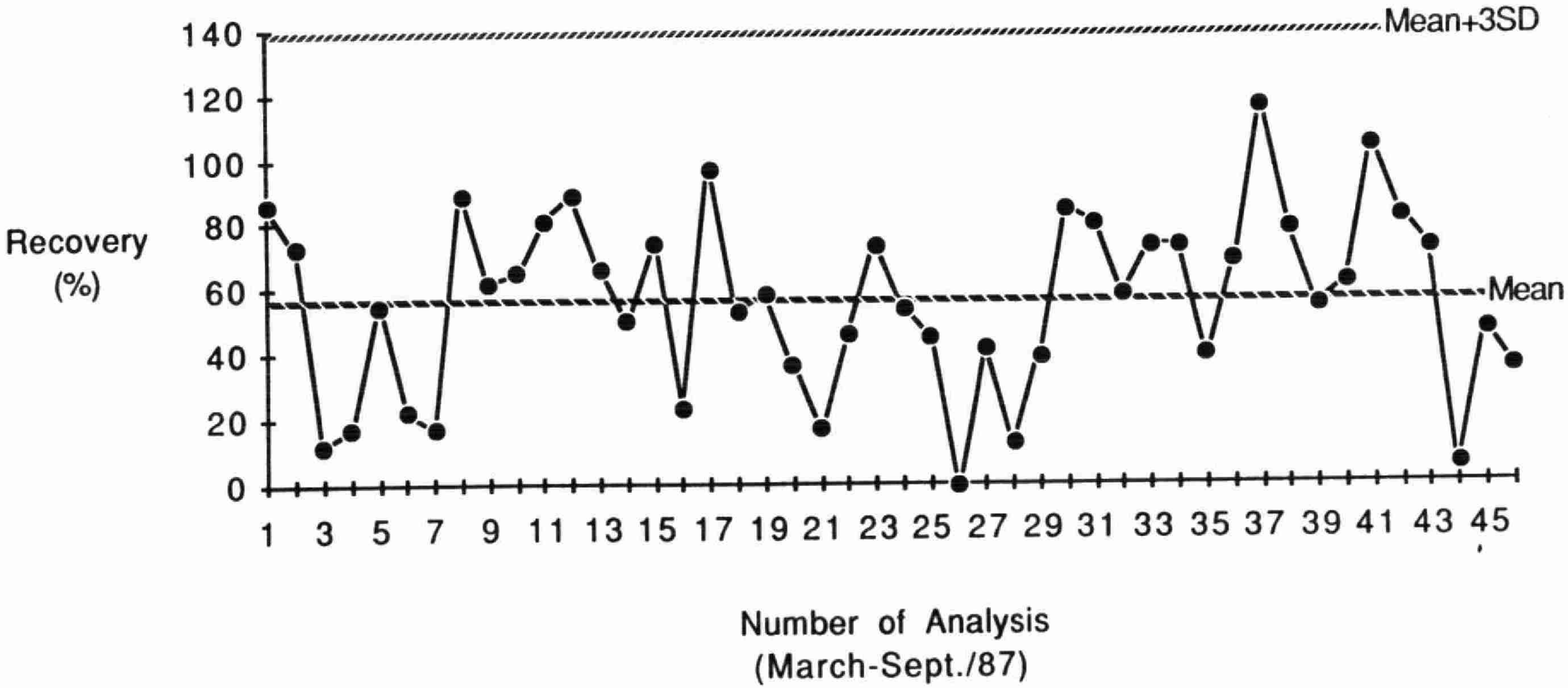



Fig. 2.4.3.1.10

# 13C12-O8CDD SURROGATE RECOVERY
(Raw Sewage)

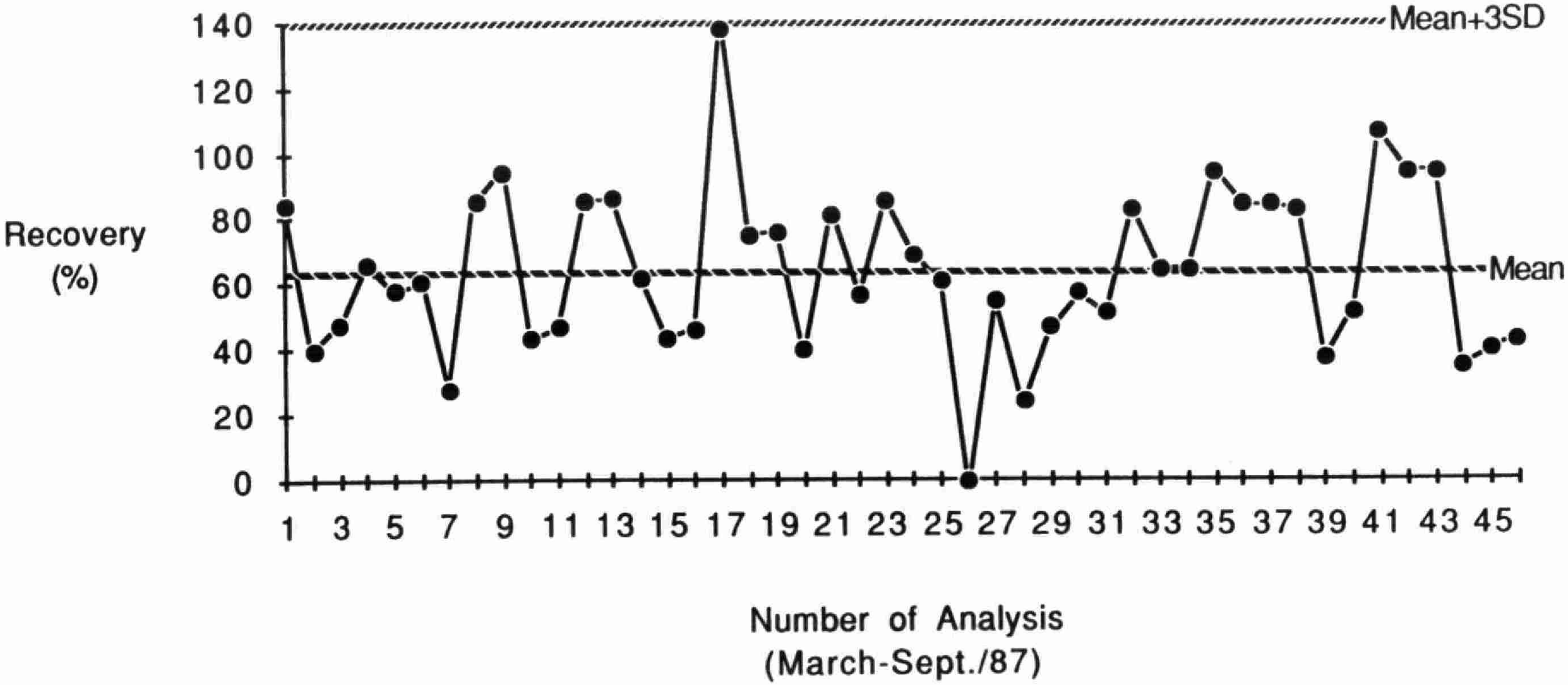



Fig. 2.4.3.1.11

**PCDD/F Surrogate Recovery**
**Box-Whisker Method**
**(Raw Sewage)**

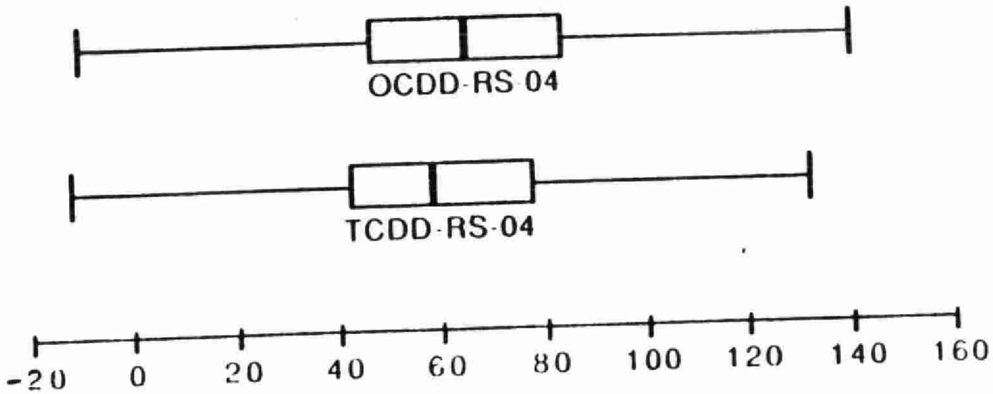





Fig. 2.4.3.1.12

# 13C12-T4CDD SURROGATE RECOVERY
(Sludge)

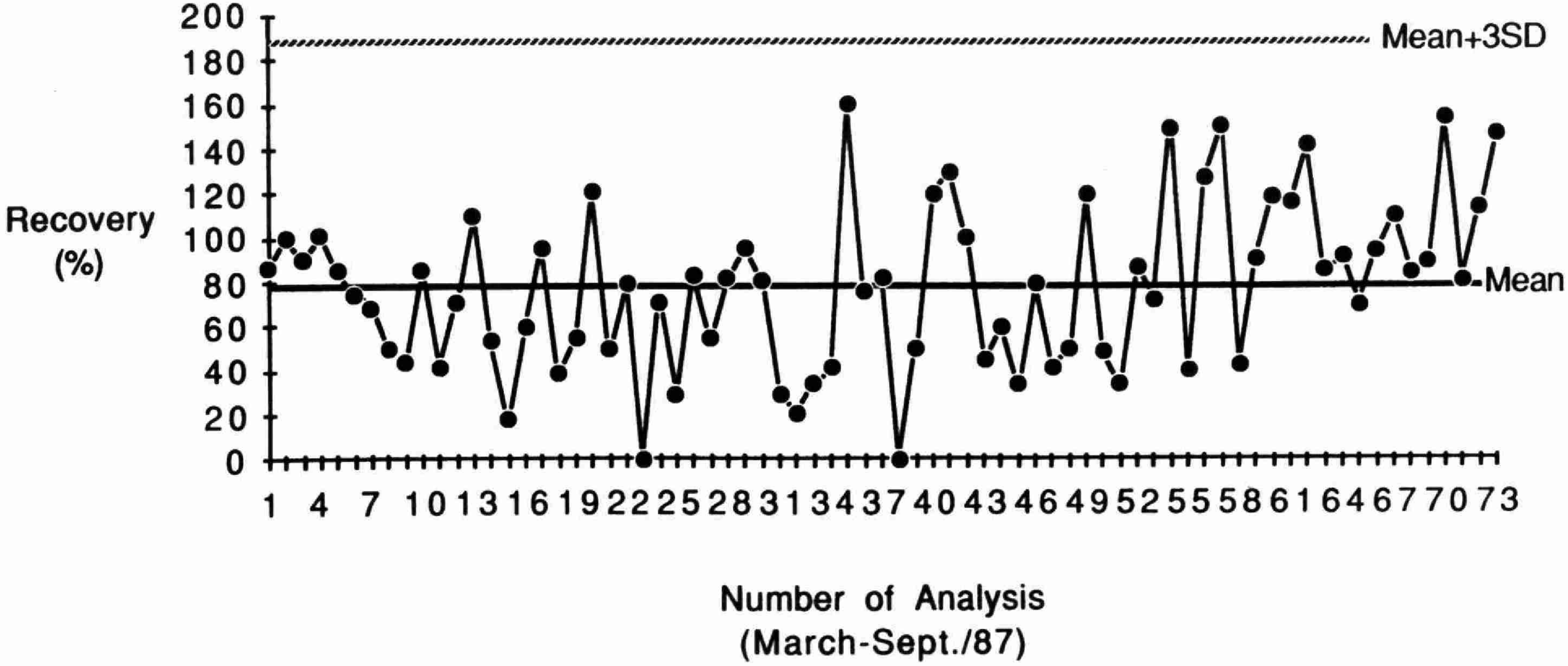



Fig. 2.4.3.1.13

## 13C12-O8CDD SURROGATE RECOVERY
## (Sludge)

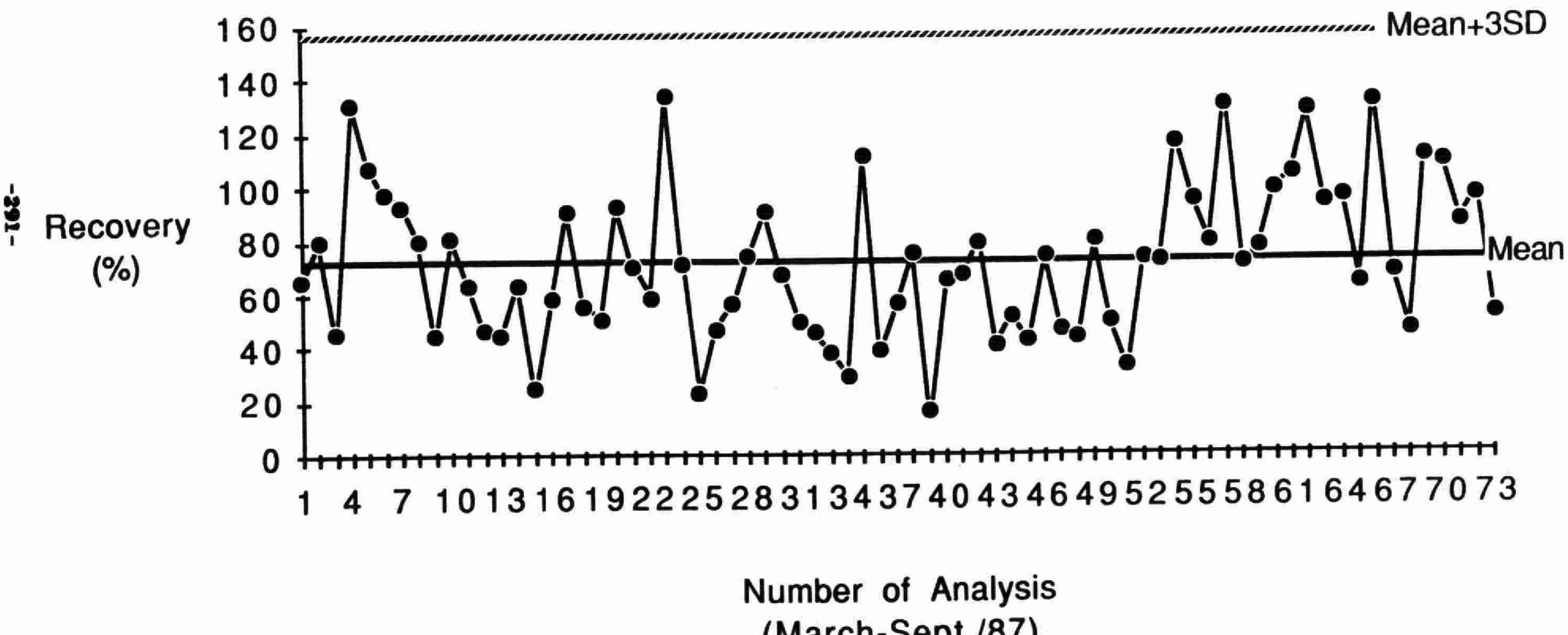





Fig. 2.4.3.1.14

**PCDD/F Surrogate Recovery**
**Box-Whisker Method**
**(Sludge)**

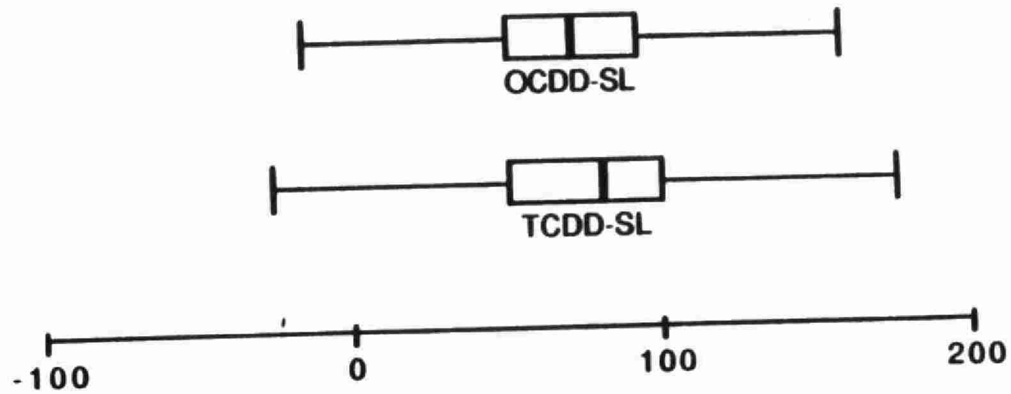



Fig. 2.4.3.1.15

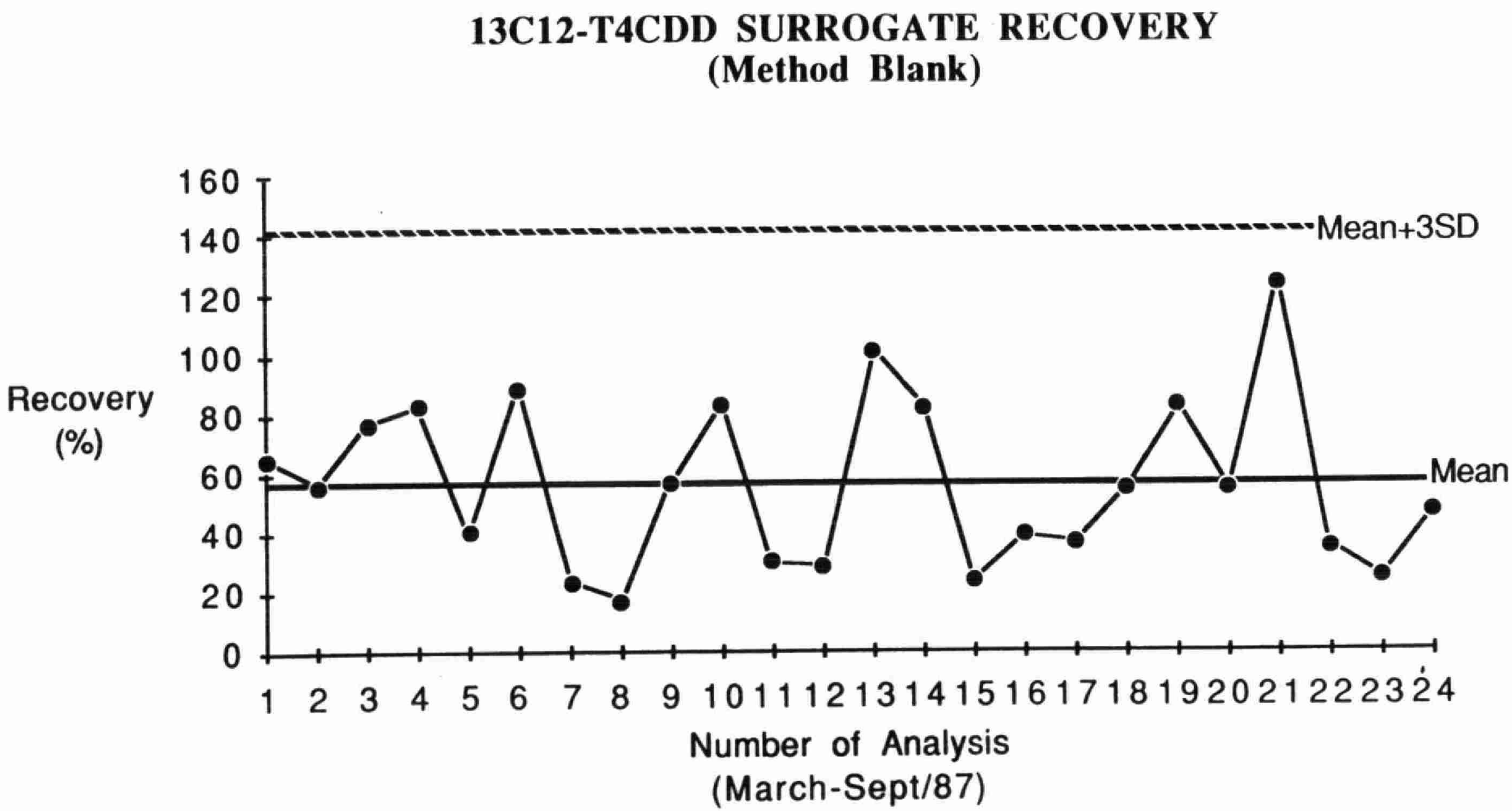

13C12-T4CDD SURROGATE RECOVERY
(Method Blank)
Recovery
(%)
160
140
120
100
80
60
40
20
0
Mean+3SD
Mean
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Number of Analysis
(March-Sept/87)

Fig. 2.4.3.1.16

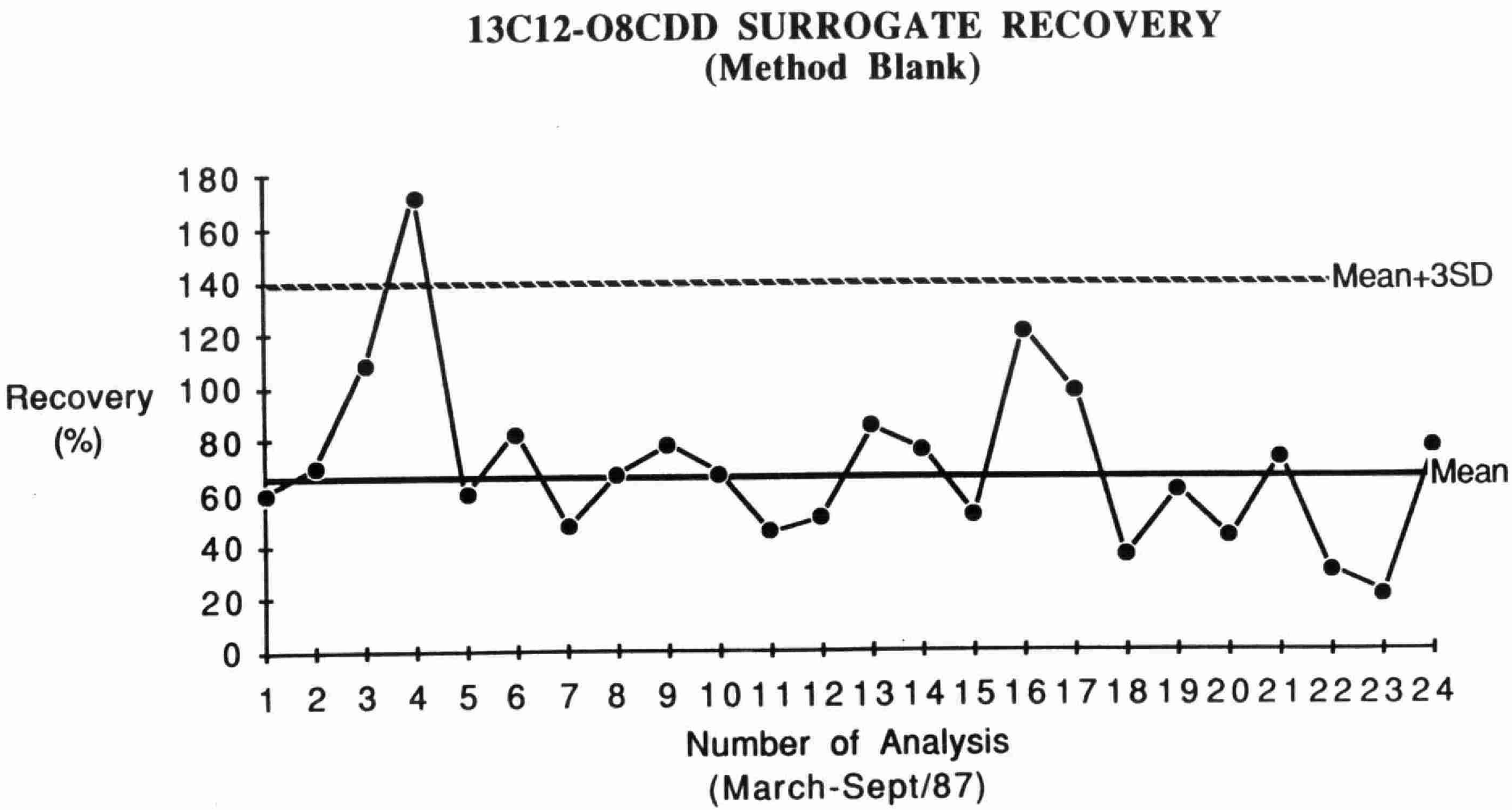

13C12-O8CDD SURROGATE RECOVERY
(Method Blank)
180
160
140
120
100
80
60
40
20
0
Recovery
(%)
Mean+3SD
Mean
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Number of Analysis
(March-Sept/87)

Fig. 2.4.3.1.17

# PCDD/F Surrogate Recovery
# Box-Whisker Method
# (Method Blank)

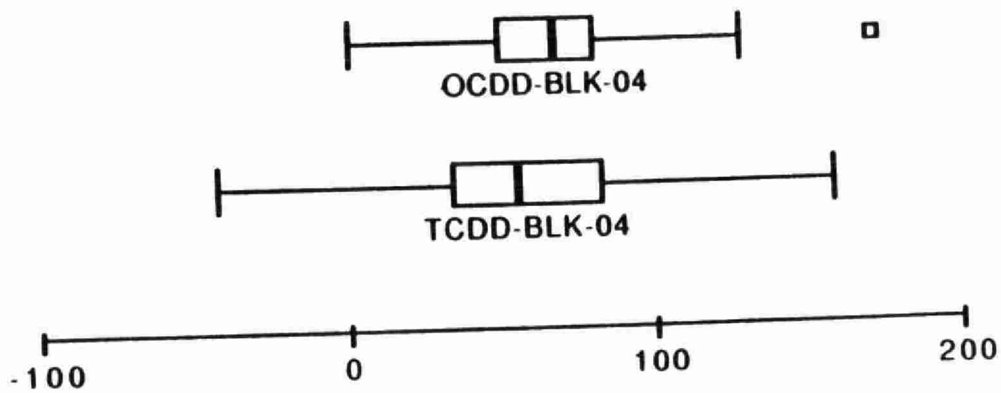





Fig. 2.4.3.1.18

# 13C12-T4CDD SURROGATE RECOVERY
## (Native Spike)

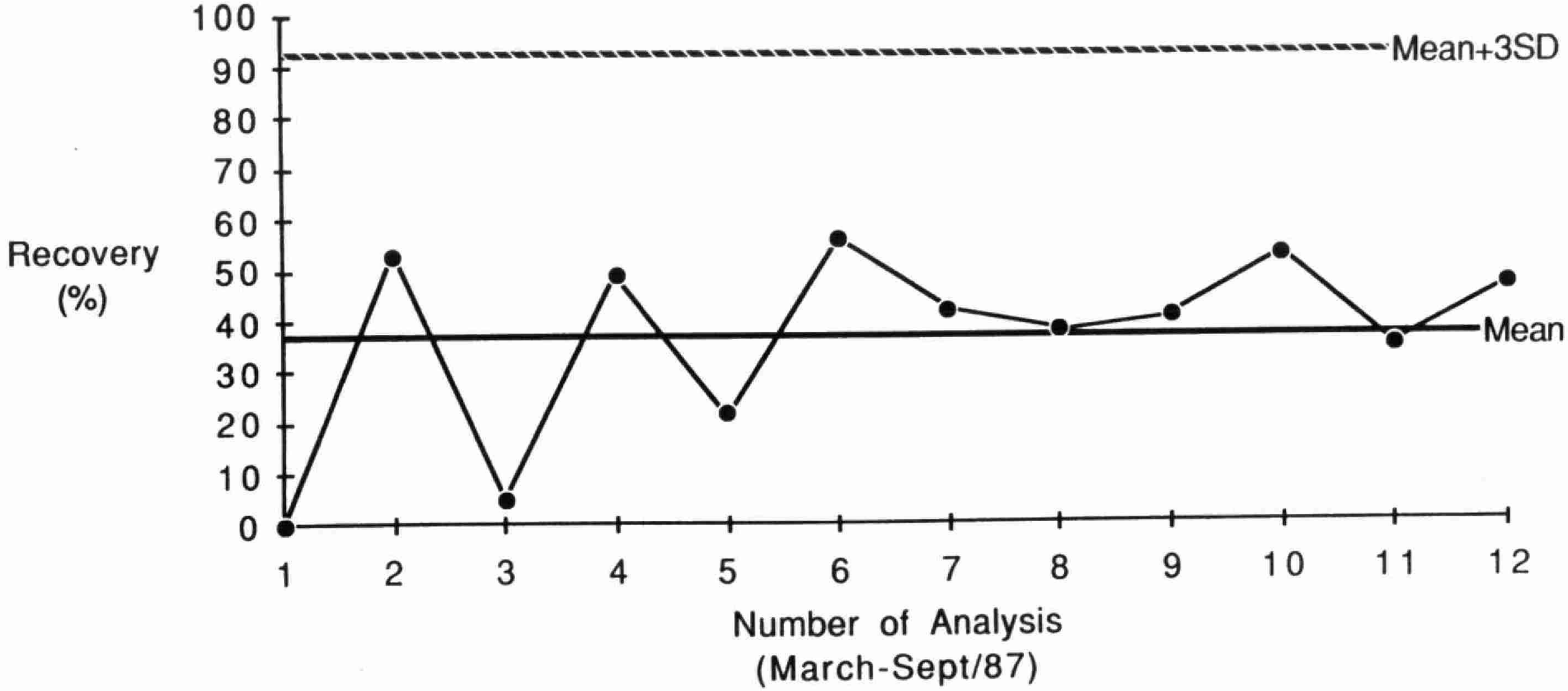



Fig. 2.4.3.1.19

# 13C12-O8CDD SURROGATE RECOVERY
## (Native Spike)

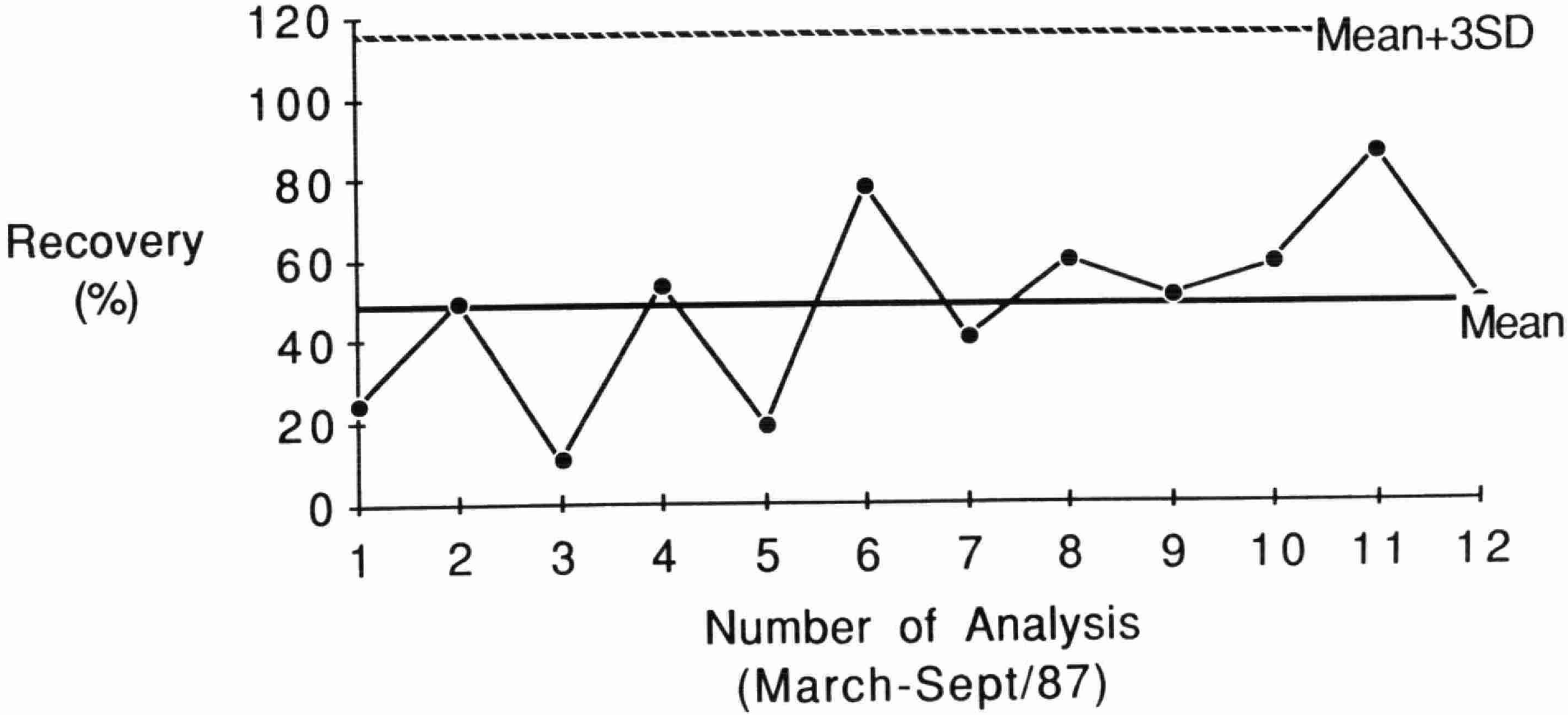



Fig. 2.4.3.1.20

# PCDD/F Surrogate Recovery
# Box-Whisker Method
# (Native Spike)

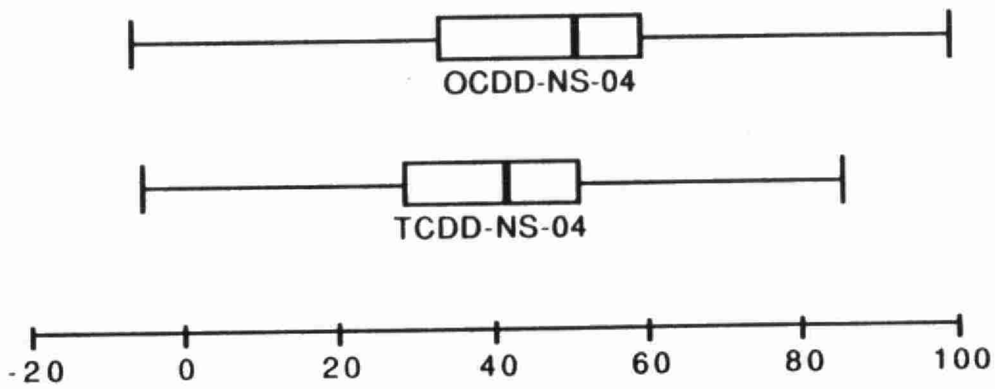





Fig. 2.4.3.1.21

## Comparison of $T_4CDD$ Surrogate Recovery (Return Recycle/Secondary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-RR-04 | T4CDD-2-FE-04 |
|---|---|---|
| Mean: | 59.062 | 51.840 |
| Std. Deviation: | 14.397 | 22.417 |
| Observations: | 8 | 48 |

| | | |
|---|---|---|
| t-statistic: | 0.878 | Hypothesis: |
| Degrees of Freedom: | 54 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.384 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between return recycle and secondary final effluent samples

Table 2.4.3.1.9

## Comparison OF $T_4CDD$ Surrogate Recovery
## (Return Recycle/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-RR-04 | T4CDD-SL-04 |
|---|---|---|
| Mean: | 59.062 | 78.345 |
| Std. Deviation: | 14.397 | 36.842 |
| Observations: | 8 | 74 |

| | | |
|---|---|---|
| t-statistic: | -1.461 | Hypothesis: |
| Degrees of Freedom: | 80 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.148 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between return recycle and sludge samples

Table 2.4.3.1.10

## Comparison of $T_4CDD$ Surrogate Recovery
## (Return Recycle/Primary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-RR-04 | T4CDD-1-FE-04 |
|---|---|---|
| Mean: | 59.062 | 60.800 |
| Std. Deviation: | 14.397 | 18.926 |
| Observations: | 8 | 8 |

| | | |
|---|---|---|
| t-statistic: | -0.207 | Hypothesis: |
| Degrees of Freedom: | 14 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.839 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4$ CDD surrogate standard recovery between return recycle and primary final effluent samples

Table 2.4.3.1.11

**Comparison of $T_4CDD$ Surrogate Recovery**
**(Return Recycle/Raw Sewage)**

Data File: STT-PCDD-04 data
Independent Samples...

| Variable: | T4CDD-RR-04 | T4CDD-RS-04 |
|---|---|---|
| Mean: | 59.062 | 58.363 |
| Std. Deviation: | 14.397 | 27.354 |
| Observations: | 8 | 54 |

| | | |
|---|---|---|
| t-statistic: | 0.071 | Hypothesis: |
| Degrees of Freedom: | 60 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.944 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between return recycle and raw sewage samples

Table 2.4.3.1.12

**Comparison of $T_4CDD$ Surrogate Recvoery**
**(Secondary Final Effluent/Sludge)**

Data File: STT-PCDD-04 data
Independent Samples...

| Variable: | T4CDD-2-FE-04 | T4CDD-SL-04 |
|---|---|---|
| Mean: | 51.840 | 78.345 |
| Std. Deviation: | 22.417 | 36.842 |
| Observations: | 48 | 74 |

| | | |
|---|---|---|
| t-statistic: | -4.472 | Hypothesis: |
| Degrees of Freedom: | 120 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.000 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($p<0.01$) recovery of $T_4CDD$ surrogate standard from sludge samples than secondary final effluent samples

Table 2.4.3.1.13

## Comparison of $T_4CDD$ Surrogate Recovery
## (Primary Final Effluent/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-1-FE-04 | T4CDD-SL-04 |
|---|---|---|
| Mean: | 60.800 | 78.345 |
| Std. Deviation: | 18.926 | 36.842 |
| Observations: | 8 | 74 |

| | | |
|---|---|---|
| t-statistic: | -1.323 | Hypothesis: |
| Degrees of Freedom: | 80 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.190 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between primary final effluent and sludge samples

Table 2.4.3.1.14

## Comparison of $T_4CDD$ Surrogate Recovery
## (Primary Final Effluent/Secondary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-1-FE-04 | T4CDD-2-FE-04 |
|---|---|---|
| Mean: | 60.800 | 51.840 |
| Std. Deviation: | 18.926 | 22.417 |
| Observations: | 8 | 48 |

| | | |
|---|---|---|
| t-statistic: | 1.067 | Hypothesis: |
| Degrees of Freedom: | 54 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.291 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate recovery between primary and secondary final effluent samples

Table 2.4.3.1.15

**Comparison of $T_4CDD$ Surrogate Recovery**
**(Raw Sewage/Secondary Final Effluent)**

Data File: STT-PCDD-04 data
Independent Samples...

| Variable: | T4CDD-RS-04 | T4CDD-2-FE-04 |
|---|---|---|
| Mean: | 58.363 | 51.840 |
| Std. Deviation: | 27.354 | 22.417 |
| Observations: | 54 | 48 |

| | | |
|---|---|---|
| t-statistic: | 1.307 | Hypothesis: |
| Degrees of Freedom: | 100 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.194 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between raw sewage and secondary final effluent samples

Table 2.4.3.1.16

## Comparison of $T_4CDD$ Surrogate Recovery
## (Raw Sewage/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-RS-04 | T4CDD-SL-04 |
|---|---|---|
| Mean: | 58.363 | 78.345 |
| Std. Deviation: | 27.354 | 36.842 |
| Observations: | 54 | 74 |

| | | |
|---|---|---|
| t-statistic: | -3.364 | Hypothesis: |
| Degrees of Freedom: | 126 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.001 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was a significantly higher ($p<0.01$) recovery of $T_4CDD$ surrogate standard from sludge samples than raw sewage samples

Table 2.4.3.1.17

**Comparison of $T_4CDD$ Surrogate Recovery (Raw Sewage/Primary Final Effluent)**

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | T4CDD-RS-04 | T4CDD-1-FE-04 |
|---|---|---|
| Mean: | 58.363 | 60.800 |
| Std. Deviation: | 27.354 | 18.926 |
| Observations: | 54 | 8 |

| | | |
|---|---|---|
| t-statistic: | -0.243 | Hypothesis: |
| Degrees of Freedom: | 60 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.809 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $T_4CDD$ surrogate standard recovery between raw sewage and primary final effluent samples

Table 2.4.3.1.18

## Comparison of $O_8CDD$ Surrogate Recovery (Secondary Final Effluent/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-2-FE-04 | O8CDD-SL-04 |
|---|---|---|
| Mean: | 66.877 | 72.302 |
| Std. Deviation: | 28.333 | 27.881 |
| Observations: | 52 | 85 |

| | | |
|---|---|---|
| t-statistic: | -1.099 | Hypothesis: |
| Degrees of Freedom: | 135 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.274 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between secondary final effluent and sludge samples

Table 2.4.3.1.19

## Comparison of $O_8CDD$ Surrogate Recovery
## (Secondary Final Effluent/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-1-FE-04 | O8CDD-SL-04 |
|---|---|---|
| Mean: | 64.357 | 72.302 |
| Std. Deviation: | 14.747 | 27.881 |
| Observations: | 7 | 85 |

| | | |
|---|---|---|
| t-statistic: | -0.743 | Hypothesis: |
| Degrees of Freedom: | 90 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.460 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between primary final effluent and sludge samples

Table 2.4.3.1.20

## Comparison of $O_8CDD$ Surrogate Recovery
## (Primary Final Effluent/Secondary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-1-FE-04 | O8CDD-2-FE-04 |
|---|---|---|
| Mean: | 64.357 | 66.877 |
| Std. Deviation: | 14.747 | 28.333 |
| Observations: | 7 | 52 |

| | | |
|---|---|---|
| t-statistic: | -0.230 | Hypothesis: |
| Degrees of Freedom: | 57 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.819 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between primary final effluent and secondary final effluent samples

Table 2.4.3.1.21

**Comparison of $O_8CDD$ Surrogate Recovery**
**(Raw Sewage/Secondary Final Effluent)**

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RS-04 | O8CDD-2-FE-04 |
|---|---|---|
| Mean: | 63.640 | 66.877 |
| Std. Deviation: | 24.778 | 28.333 |
| Observations: | 57 | 52 |

| | | |
|---|---|---|
| t-statistic: | -0.636 | Hypothesis: |
| Degrees of Freedom: | 107 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.526 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between raw sewage and secondary final effluent samples

Table 2.4.3.1.22

## Comparison of $O_8CDD$ Surrogate Recovery
## (Raw Sewage/Sludge)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RS-04 | O8CDD-SL-04 |
|---|---|---|
| Mean: | 63.640 | 72.302 |
| Std. Deviation: | 24.778 | 27.881 |
| Observations: | 57 | 85 |

| | | |
|---|---|---|
| t-statistic: | -1.896 | Hypothesis: |
| Degrees of Freedom: | 140 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.060 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($p<0.1$) recovery of $O_8CDD$ surrogate standard from sludge samples than raw sewage samples

Table 2.4.3.1.23

## Comparison of $O_8CDD$ Surrogate Recovery (Raw Sewage/Primary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RS-04 | O8CDD-1-FE-04 |
|---|---|---|
| Mean: | 63.640 | 64.357 |
| Std. Deviation: | 24.778 | 14.747 |
| Observations: | 57 | 7 |

| | | |
|---|---|---|
| t-statistic: | -0.075 | Hypothesis: |
| Degrees of Freedom: | 62 | Ho: $\mu 1 = \mu 2$ |
| Significance: | 0.941 | Ha: $\mu 1 \neq \mu 2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between raw sewage and primary final effluent samples

Table 2.4.3.1.24

**Comparison of $O_8CDD$ Surrogate Recovery (Return Recycle/Secondary Final Effluent)**

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RR-04 | O8CDD-2-FE-04 |
|---|---|---|
| Mean: | 64.722 | 66.877 |
| Std. Deviation: | 20.499 | 28.333 |
| Observations: | 9 | 52 |

| | | |
|---|---|---|
| t-statistic: | -0.218 | Hypothesis: |
| Degrees of Freedom: | 59 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.828 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate recovery between return recycle and secondary final effluent samples

Table 2.4.3.1.25

**Comparison of $O_8CDD$ Surrogate Recovery (Return Recycle/Sludge)**

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RR-04 | O8CDD-SL-04 |
|---|---|---|
| Mean: | 64.722 | 72.302 |
| Std. Deviation: | 20.499 | 27.881 |
| Observations: | 9 | 85 |

| | | |
|---|---|---|
| t-statistic: | -0.792 | Hypothesis: |
| Degrees of Freedom: | 92 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.431 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between return recycle and sludge samples

Table 2.4.3.1.26

## Comparison of $O_8CDD$ Surrogate Recovery
## (Return Recycle/Primary Final Effluent)

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RR-04 | O8CDD-1-FE-04 |
|---|---|---|
| Mean: | 64.722 | 64.357 |
| Std. Deviation: | 20.499 | 14.747 |
| Observations: | 9 | 7 |

| | | |
|---|---|---|
| t-statistic: | 0.040 | Hypothesis: |
| Degrees of Freedom: | 14 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.969 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of $O_8CDD$ surrogate standard recovery between return recycle and primary final effluent sampels

Table 2.4.3.1.27

**Comparison of $O_8CDD$ Surrogate Recovery (Return Recycle/Raw Sewage)**

Data File: STT-PCDD-04 data

Independent Samples...

| Variable: | O8CDD-RR-04 | O8CDD-RS-04 |
|---|---|---|
| Mean: | 64.722 | 63.640 |
| Std. Deviation: | 20.499 | 24.778 |
| Observations: | 9 | 57 |

| | | |
|---|---|---|
| t-statistic: | 0.124 | Hypothesis: |
| Degrees of Freedom: | 64 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.902 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no siginificant difference of $O_8CDD$ surrogate standard recovery between return recycle and raw sewage sampels

Table 2.4.3.1.28

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst OC

Instrument MS/GC Analysis Date 10-Mar-87

Matrix Type NATIVE SPIKE

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF * | 1000 | 0 | 103 | 10% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 588 | 59% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 736 | 74% | 50-110% |
| ΣPenta-CDD * | 1000 | 0 | 481 | 48% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 981 | 98% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 823 | 82% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 965 | 97% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 714 | 71% | 50-110% |
| Octa-CDF | 1000 | 0 | 857 | 86% | 50-110% |
| Octa-CDD | 1000 | 0 | 689 | 69% | 50-110% |
| Average | | | | 69.4 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.1

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst OC

Instrument MS/GC Analysis Date 31-Mar-87

Matrix Type Native spike

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF* | 1000 | 0 | 300 | 30% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 670 | 67% | 50-110% |
| ΣPenta-CDF * | 1000 | 0 | 363 | 36% | 50-110% |
| ΣPenta-CDD * | 1000 | 0 | 340 | 34% | 50-110% |
| ΣHexa-CDF * | 1000 | 0 | 385 | 39% | 50-110% |
| ΣHexa-CDD * | 1000 | 0 | 406 | 41% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 495 | 50% | 50-110% |
| ΣHepta-CDD * | 1000 | 0 | 470 | 47% | 50-110% |
| Octa-CDF | 1000 | 0 | 514 | 51% | 50-110% |
| Octa-CDD * | 1000 | 0 | 403 | 40% | 50-110% |
| Average | | | | 43.5 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.2

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst OC

Instrument MS/GC Analysis Date 7-Apr-87

Matrix Type NATIVE SPIKE

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF * | 1000 | 0 | 454 | 45% | 50-110% |
| ΣTetra-CDD * | 1000 | 0 | 390 | 39% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 695 | 70% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 689 | 69% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 718 | 72% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 797 | 80% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 969 | 97% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 937 | 94% | 50-110% |
| Octa-CDF | 1000 | 0 | 596 | 60% | 50-110% |
| Octa-CDD | 1000 | 0 | 758 | 76% | 50-110% |
| Average | | | | 70.0 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.3

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst QC

Instrument MS/GC Analysis Date Apr.24/87

Matrix Type Native spike

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 783 | 78% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 878 | 88% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 1009 | 101% | 50-110% |
| ΣPenta-CDD * | 1000 | 0 | 444 | 44% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 991 | 99% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 1021 | 102% | 50-110% |
| ΣHepta-CDF * | 1000 | 0 | 1711 | 171% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 1151 | 115% | 50-110% |
| Octa-CDF | 1000 | 0 | 909 | 91% | 50-110% |
| Octa-CDD | 1000 | 0 | 1463 | 146% | 50-110% |
| Average | | | | 103.6 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.4

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY SUMMARY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC |
| Instrument | MS/GC | Analysis Date | 2-May-87 |
| Matrix Type | Native spike | | |

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 790 | 79% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 880 | 88% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 1000 | 100% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 930 | 93% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 1000 | 100% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 1100 | 110% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 880 | 88% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 1100 | 110% | 50-110% |
| Octa-CDF | 1000 | 0 | 880 | 88% | 50-110% |
| Octa-CDD | 1000 | 0 | 840 | 84% | 50-110% |
| Average | | | | 94.0 % | |

Table 2.4.3.2.5

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | MM |
| Instrument | MS/GC | Analysis Date | 17-May-87 |
| Matrix Type | Native spike | | |

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC Action Limits Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 680 | 68% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 652 | 65% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 658 | 66% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 647 | 65% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 616 | 62% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 590 | 59% | 50-110% |
| ΣHepta-CDF * | 1000 | 0 | 1273 | 127% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 1047 | 105% | 50-110% |
| Octa-CDF * | 1000 | 0 | 327 | 33% | 50-110% |
| Octa-CDD * | 1000 | 0 | 368 | 37% | 50-110% |
| Average | | | | 68.6 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.6

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst MM

Instrument MS/GC Analysis Date 25-May-87

Matrix Type Native spike

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC Action Limits Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF * | 1000 | 0 | 351 | 35% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 601 | 60% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 635 | 64% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 500 | 50% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 521 | 52% | 50-110% |
| ΣHexa-CDD * | 1000 | 0 | 420 | 42% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 1012 | 101% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 646 | 65% | 50-110% |
| Octa-CDF | 1000 | 0 | 793 | 79% | 50-110% |
| Octa-CDD | 1000 | 0 | 705 | 71% | 50-110% |
| Average | | | | 61.8 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.7

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | MM |
| Instrument | MS/GC | Analysis Date | 2-Jun-87 |
| Matrix Type | Native spike | | |

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC Action Limits Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 588 | 59% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 720 | 72% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 810 | 81% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 846 | 85% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 1084 | 108% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 583 | 58% | 50-110% |
| ΣHepta-CDF * | 1000 | 0 | 1392 | 139% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 828 | 83% | 50-110% |
| Octa-CDF | 1000 | 0 | 1090 | 109% | 50-110% |
| Octa-CDD | 1000 | 0 | 1058 | 106% | 50-110% |
| Average | | | | 90.0 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.8

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | MM |
| Instrument | MS/GC | Analysis Date | 21-Jul-87 |
| Matrix Type | Native spike | | |

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC Action Limits Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 629 | 63% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 621 | 62% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 527 | 53% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 641 | 64% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 727 | 73% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 552 | 55% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 563 | 56% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 611 | 61% | 50-110% |
| Octa-CDF | 1000 | 0 | 831 | 83% | 50-110% |
| Octa-CDD * | 1000 | 0 | 1311 | 131% | 50-110% |
| Average | | | | 70.1 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.9

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst QC

Instrument MS/GC Analysis Date 6-Aug-87

Matrix Type NATIVE SPIKE

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF | 1000 | 0 | 562 | 56% | 50-110% |
| ΣTetra-CDD * | 1000 | 0 | 224 | 22% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 499 | 50% | 50-110% |
| ΣPenta-CDD * | 1000 | 0 | 429 | 43% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 636 | 64% | 50-110% |
| ΣHexa-CDD * | 1000 | 0 | 447 | 45% | 50-110% |
| ΣHepta-CDF | 1000 | 0 | 631 | 63% | 50-110% |
| ΣHepta-CDD * | 1000 | 0 | 458 | 46% | 50-110% |
| Octa-CDF | 1000 | 0 | 609 | 61% | 50-110% |
| Octa-CDD | 1000 | 0 | 648 | 65% | 50-110% |
| Average | | | | 51.4 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.10

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

Project ID: AN873095 Analyst OC

Instrument MS/GC Analysis Date 2-Sep-87

Matrix Type NATIVE SPIKE

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF * | 1000 | 0 | 1279 | 128% | 50-110% |
| ΣTetra-CDD * | 1000 | 0 | 1486 | 149% | 50-110% |
| ΣPenta-CDF * | 1000 | 0 | 1174 | 117% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 952 | 95% | 50-110% |
| ΣHexa-CDF | 1000 | 0 | 1076 | 108% | 50-110% |
| ΣHexa-CDD | 1000 | 0 | 1076 | 108% | 50-110% |
| ΣHepta-CDF * | 1000 | 0 | 1252 | 125% | 50-110% |
| ΣHepta-CDD * | 1000 | 0 | 1181 | 118% | 50-110% |
| Octa-CDF | 1000 | 0 | 936 | 94% | 50-110% |
| Octa-CDD * | 1000 | 0 | 1366 | 137% | 50-110% |
| Average | | | | 117.8 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.11

ZENON ENVIRONMENTAL INC.

PCDD/F-MATRIX SPIKE RECOVERY

| | | | |
|---|---|---|---|
| Project ID: | AN873095 | Analyst | OC |
| Instrument | MS/GC | Analysis Date | Mar. 20/87 |
| Matrix Type | NATIVE SPIKE | | |

| PARAMETER | AMOUNT ADDED ng/L | SAMPLE CONC. ng/L | AMOUNT FOUND ng/L | MATRIX SPIKE % REC. | QA/QC ACTION LIMITS Rec. Range |
|---|---|---|---|---|---|
| ΣTetra-CDF * | 1000 | 0 | 180 | 18% | 50-110% |
| ΣTetra-CDD | 1000 | 0 | 1050 | 105% | 50-110% |
| ΣPenta-CDF | 1000 | 0 | 790 | 79% | 50-110% |
| ΣPenta-CDD | 1000 | 0 | 800 | 80% | 50-110% |
| ΣHexa-CDF * | 1000 | 0 | 1300 | 130% | 50-110% |
| ΣHexa-CDD * | 1000 | 0 | 2900 | 290% | 50-110% |
| ΣHepta-CDF * | 1000 | 0 | 1500 | 150% | 50-110% |
| ΣHepta-CDD | 1000 | 0 | 680 | 68% | 50-110% |
| Octa-CDF * | 1000 | 0 | 1300 | 130% | 50-110% |
| Octa-CDD | 1000 | 0 | 770 | 77% | 50-110% |
| Average | | | | 112.7 % | |

* outside the Zenon QA/QC limits

Table 2.4.3.2.12

## PCDD NATIVE SPIKE RECOVERY CHART

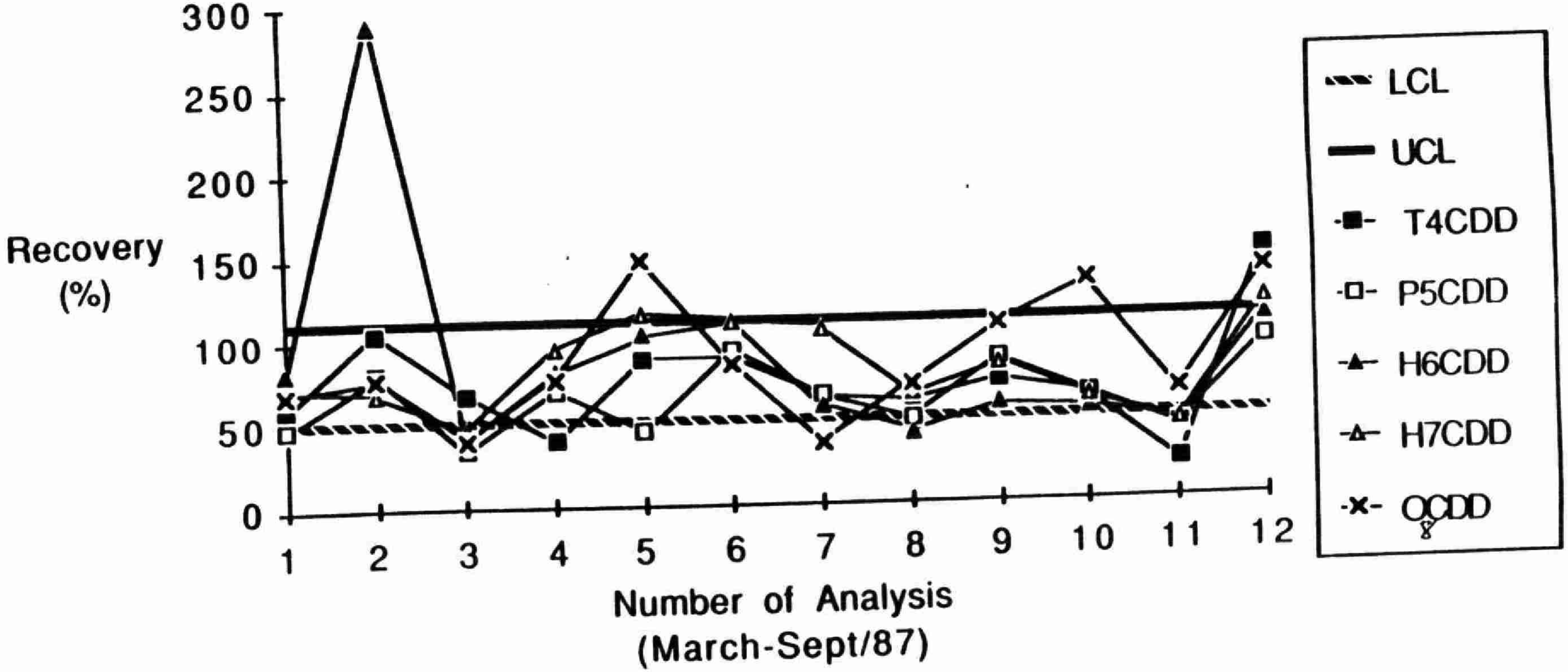



Fig. 2.4.3.2.1

# PCDF NATIVE SPIKE RECOVERY CHART

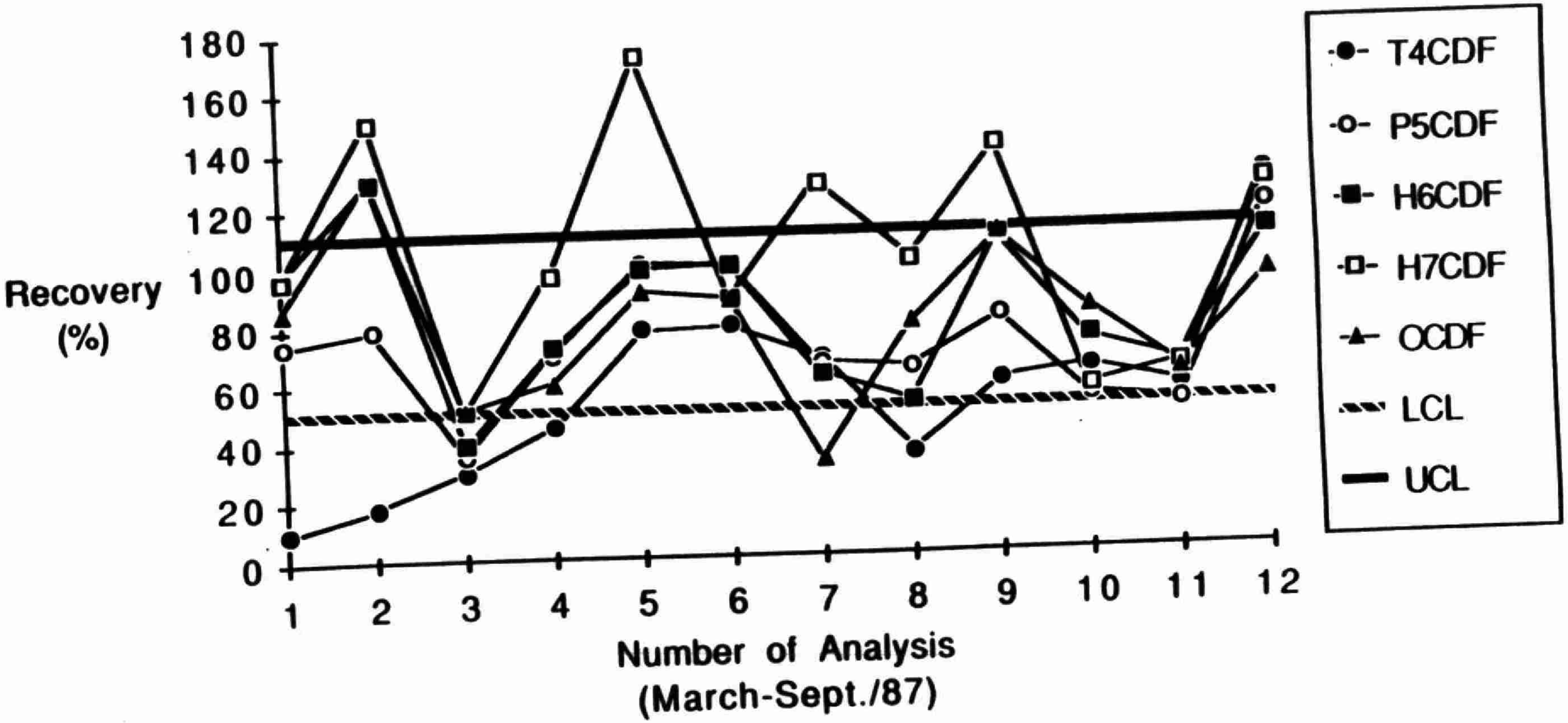



Fig. 2.4.3.2.2

**Native Spike Recovery**
**Box-Whisker Method**
**($H_7CDF/OCDF$)**

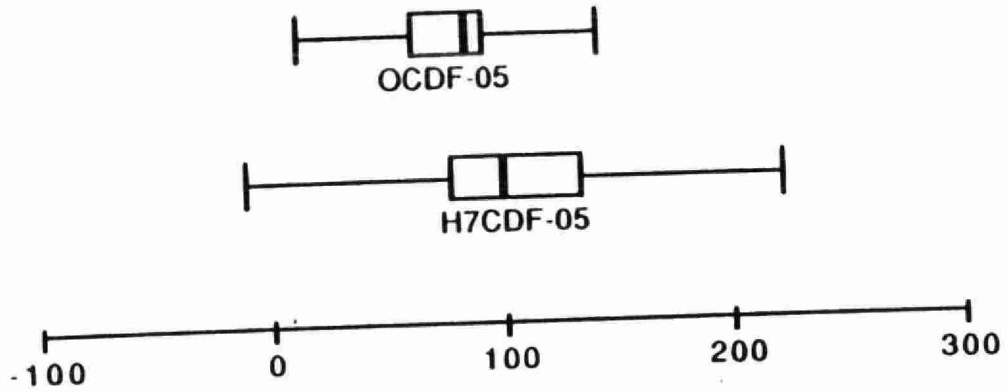





Fig. 2.4.3.2.3

**Native Spike Recovery**
**Box-Whisker Method**
**(PCDF/$H_6$CDF)**

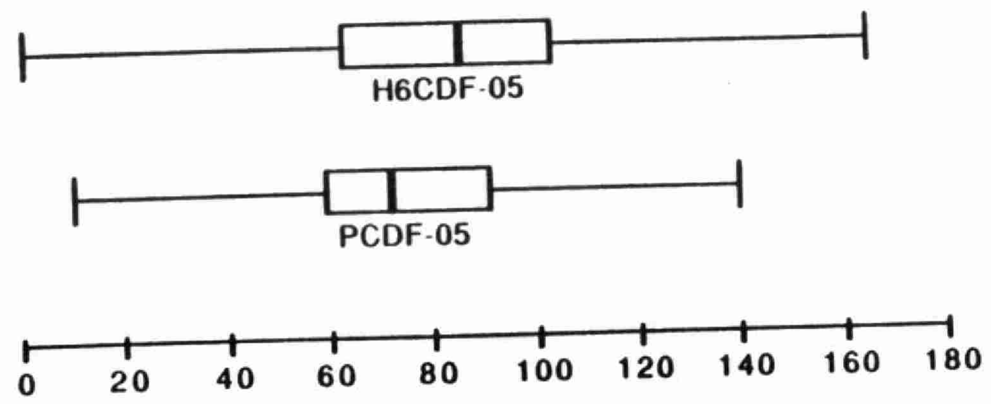



Fig. 2.4.3.2.4

Native Spike Recovery
Box-Whisker Method
(TCDD/PCDD/$H_6$CDD)

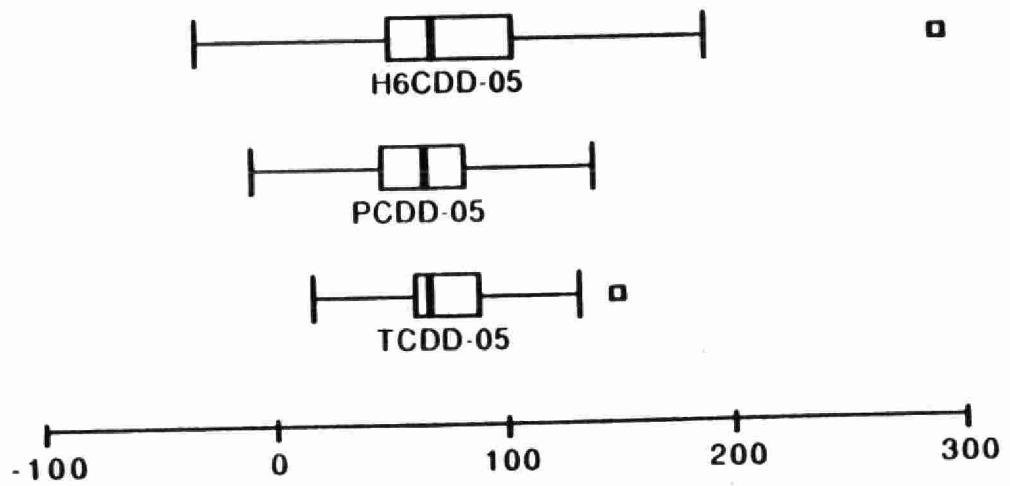





Fig. 2.4.3.2.5

**Native Spike Recovery**
**Box-Whisker Method**
**($H_7$CDD/OCDD/TCDF)**

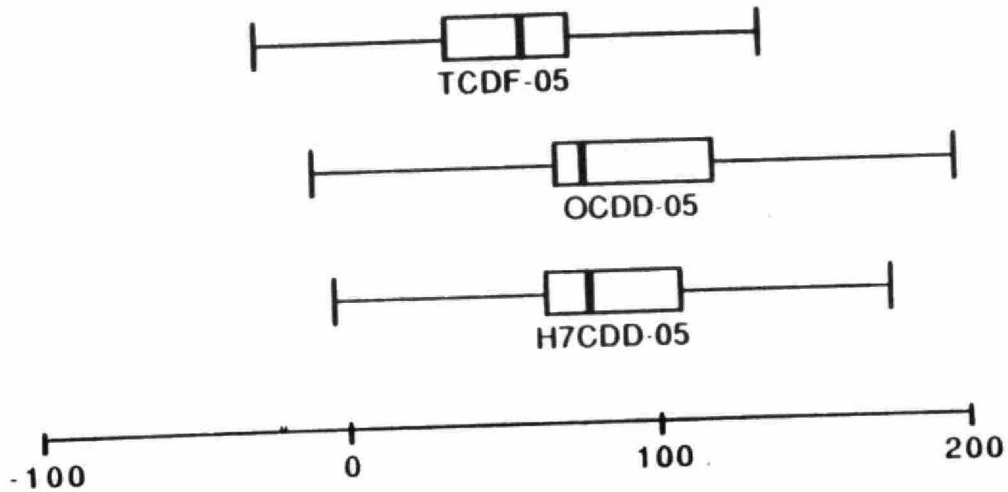



Fig. 2.4.3.2.6

# APPENDIX 2.5

## TOTAL PHENOLS MATRIX SPIKE RECOVERY

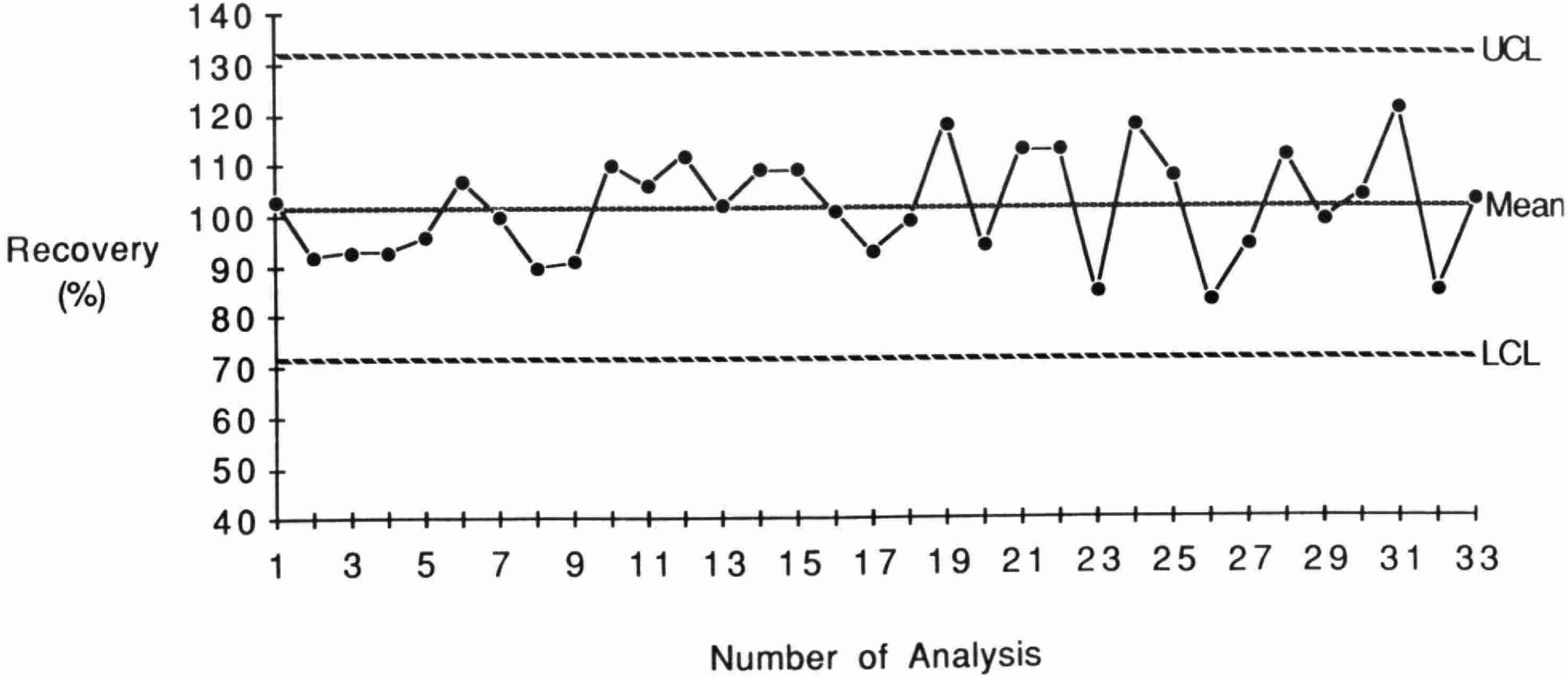
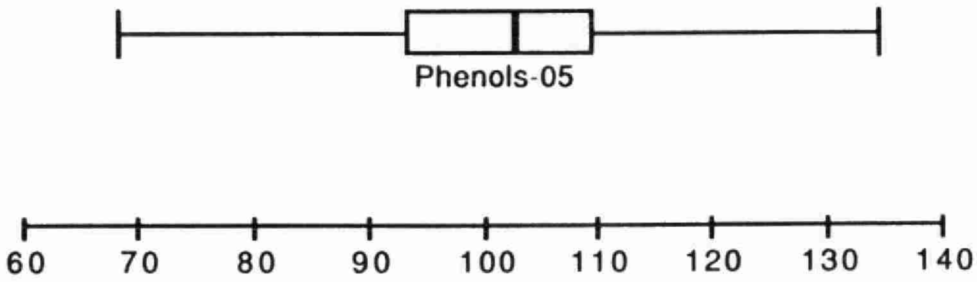



Fig. 2.5.3.1.1

## Outlier Determination by Box-Whisker Method
## (Total Phenols Matrix Spike Recovery)






Conclusion:

There was no outlier in the data set

Fig. 2.5.3.1.2

**Comparison of Total Phenols Matrix Spike Recovery (Secondary Final Effluent/ Raw Sewage)**

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | 2-FE-PHENOLS | RS-PHENOLS |
|---|---|---|
| Mean: | 106.250 | 101.417 |
| Std. Deviation: | 10.906 | 7.292 |
| Observations: | 12 | 12 |

| | | |
|---|---|---|
| t-statistic: | 1.276 | Hypothesis: |
| Degrees of Freedom: | 22 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.215 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of total phenols matrix spike recovery between secondary final effluent and raw sewage samples

Table 2.5.3.1.2

**Comparison of Total Phenols Matrix Spike Recovery (Secondary Final Effluent/Sludge)**

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | 2-FE-PHENOLS | SL-PHENOLS |
|---|---|---|
| Mean: | 106.250 | 97.000 |
| Std. Deviation: | 10.906 | 11.113 |
| Observations: | 12 | 5 |

| | | |
|---|---|---|
| t-statistic: | 1.585 | Hypothesis: |
| Degrees of Freedom: | 15 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.134 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of total phenols matrix spike recovery between secondary final effluent and sludge samples

Table 2.5.3.1.3

## Comparison of Total Phenols Matrix Spike Recovery
## (Raw Sewage/Sludge)

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | RS-PHENOLS | SL-PHENOLS |
|---|---|---|
| Mean: | 101.417 | 97.000 |
| Std. Deviation: | 7.292 | 11.113 |
| Observations: | 12 | 5 |

| | | |
|---|---|---|
| t-statistic: | 0.978 | Hypothesis: |
| Degrees of Freedom: | 15 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.343 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of total phenols matrix spike recovery between raw sewage and sludge samples

Table 2.5.3.1.4

**Comparison of Total Phenols Matrix Spike Recvoery (Secondary Final Effluent/ Return Recycle)**

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | 2-FE-PHENOLS | RR-PHENOLS |
|---|---|---|
| Mean: | 106.250 | 87.500 |
| Std. Deviation: | 10.906 | 3.536 |
| Observations: | 12 | 2 |

| | | |
|---|---|---|
| t-statistic: | 2.340 | Hypothesis: |
| Degrees of Freedom: | 12 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.037 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($p<0.05$) total phenols matrix spike recovery from secondary final effluent samples than return recycle samples

Table 2.5.3.1.5

**Comparison of Total Phenols Matrix Spike Recovery**
**(Raw Sewage/Return Recycle)**

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | RS-PHENOLS | RR-PHENOLS |
|---|---|---|
| Mean: | 101.417 | 87.500 |
| Std. Deviation: | 7.292 | 3.536 |
| Observations: | 12 | 2 |

| | | |
|---|---|---|
| t-statistic: | 2.582 | Hypothesis: |
| Degrees of Freedom: | 12 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.024 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was a significantly higher ($p<0.05$) total phenols matrix spike recovery from raw sewage samples than return recycle samples

Table 2.5.3.1.6

**Comparison of Total Phenols Matrix Spike Recovery**
**(Sludge/Return Recycle)**

Data File: PHENOLS-05-STT DATA

Independent Samples...

| Variable: | SL-PHENOLS | RR-PHENOLS |
|---|---|---|
| Mean: | 97.000 | 87.500 |
| Std. Deviation: | 11.113 | 3.536 |
| Observations: | 5 | 2 |

| | | |
|---|---|---|
| t-statistic: | 1.128 | Hypothesis: |
| Degrees of Freedom: | 5 | Ho: $\mu1 = \mu2$ |
| Significance: | 0.310 | Ha: $\mu1 \neq \mu2$ |

Conclusion:

There was no significant difference of total phenols matrix spike recovery between sludge and return recycle samples

Table 2.5.3.1.7

| | DATE DUE | | |
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